APR 5 - 1932

ELECTRICAL WORLD

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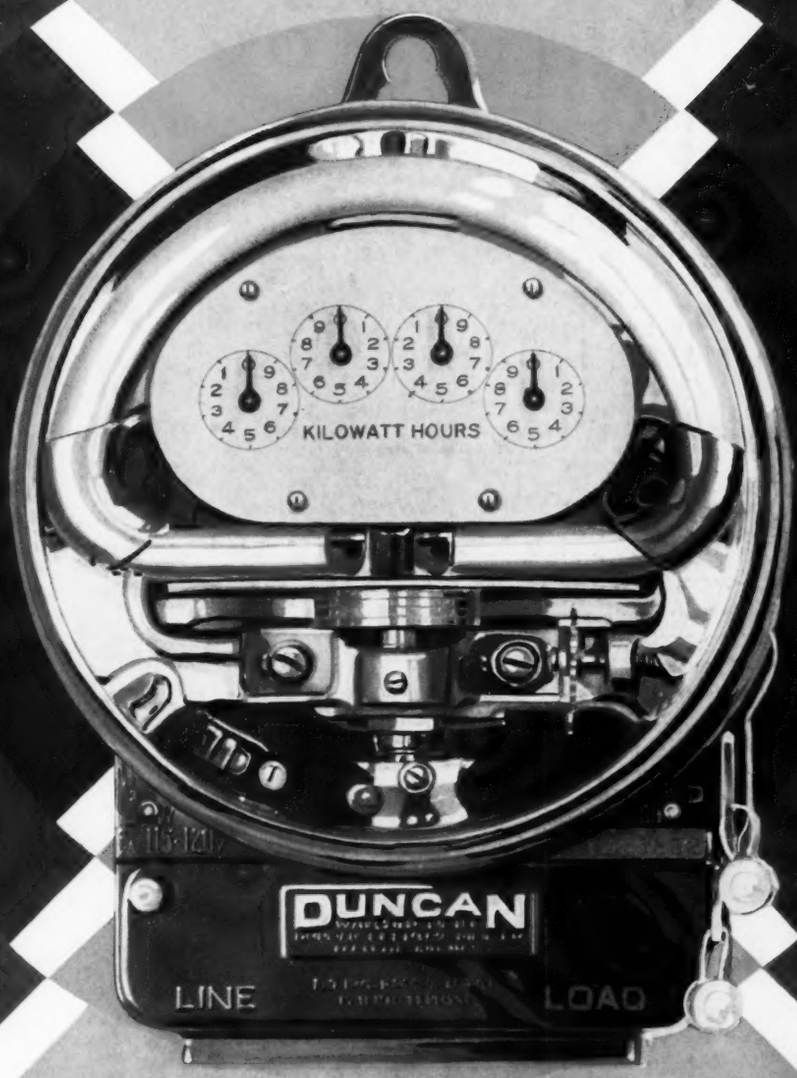

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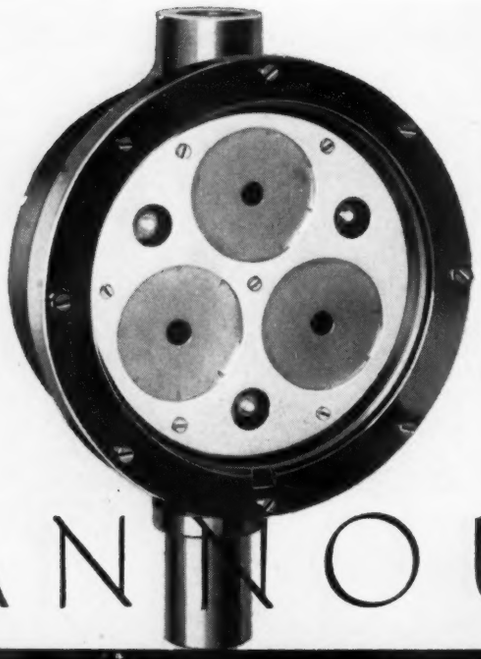

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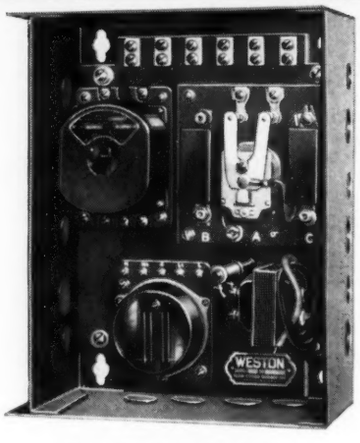

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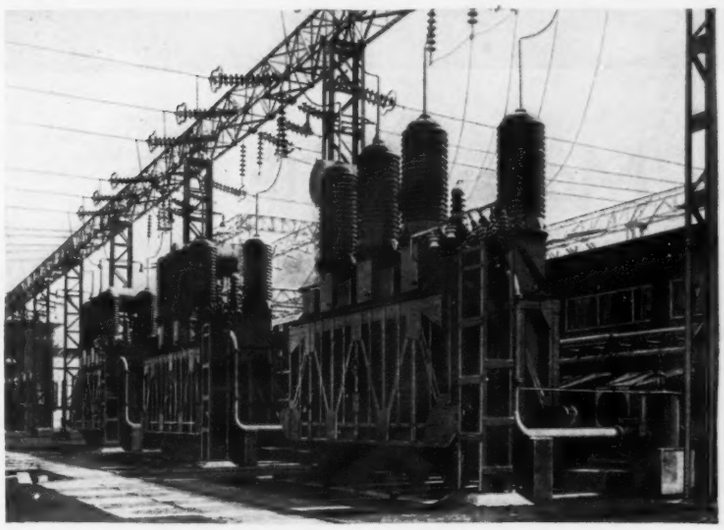

60,000-kva., 220/110-kv. transformers
Brauweiler Station, Germany

APRIL 2, 1932

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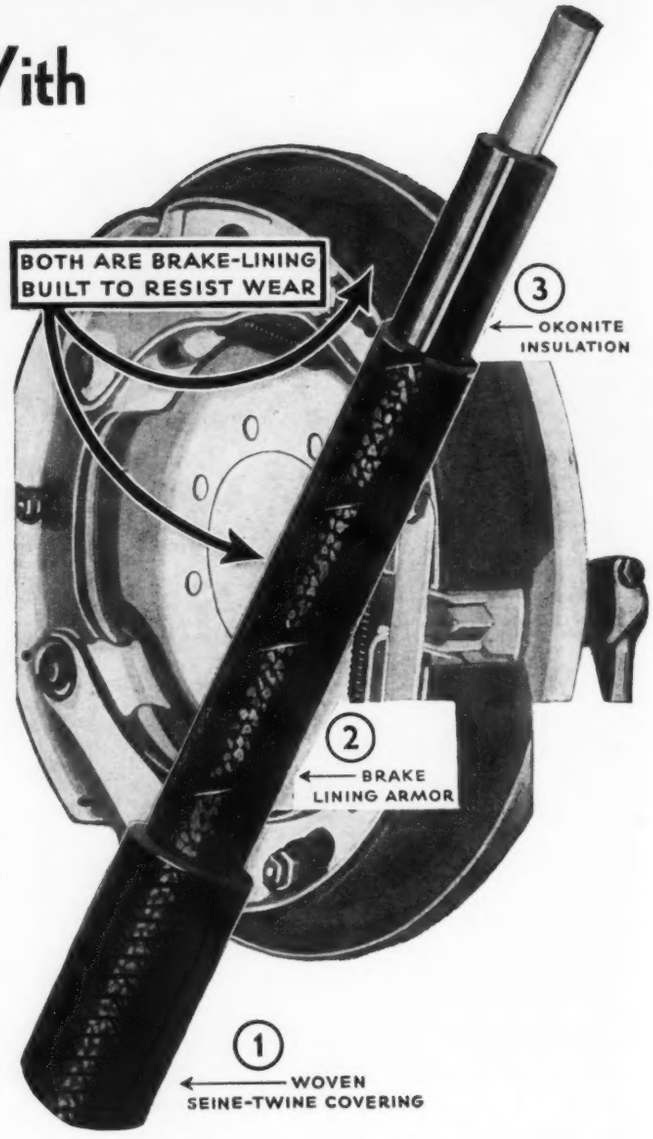

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ELECTRICAL WORLD

Established 1883. McGraw-Hill Publishing Company, Inc.

for the Week Ending

April 2, 1932

If operating utilities should be subject to regulation, as they are, why should not the real operator of these operating utilities be regulated? The states have not met this question. This has encouraged the idea of federal regulation.

W. A. PRENDERGAST,
Former Chairman
New York Public Service Commission.

[Mr. Prendergast lectured at Union College last week and advocated a combination of federal and state jurisdiction, p. 599.]

B. F. Weadock succeeds Clapp at N.E.L.A.

—**As the new managing director** New York lawyer, who was the special counsel for various utility groups in the Federal Trade Commission investigation, tackles a big job—*p. 594.*

—**Automatic frequency control.** Operating experience shows bridge type of controller to be somewhat more flexible but not so well adapted to parallel operation as pendulum-type—*p. 618.*

His Excellency the Electrical Ambassador

—**Britain's electrical emissary** is not an automaton but a highly energetic representative whose appointment was sponsored by the B.E.A.M.A. and who will stimulate trade in the Argentine—*p. 600.*

—**Tiger Creek efficiency high** owing to minimization of jet disturbances. Features include methods of load rejection and governing. Two 36,000-hp. impulse wheels have been installed in this plant—*p. 608.*

—**Dnieperstroy is progressing,** and plans for a variety of industrial plants to be served with electricity from Russia's great hydro show place are growing, too—*p. 595.*

—**Automatic typesetting arrives** as the latest marvel of the machine age. Linotype machine operates directly from copy without human effort, through the medium of the ever-astounding photo-electric cell—*p. 603.*

Improved control cuts paper-mill costs

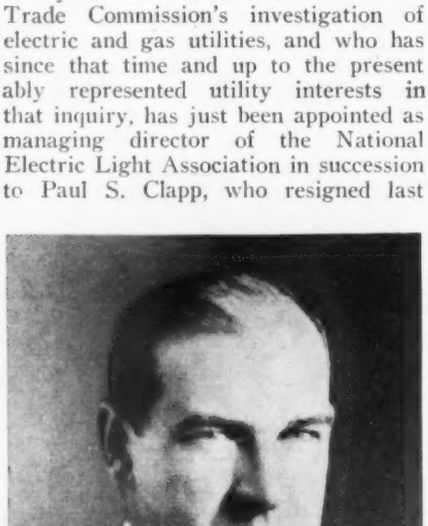
—**Synchronized super-calenders** eliminate a rewinding operation at the plant of the Bryant Paper Company, thereby introducing a notable production economy. All calender operations centralized here—*p. 617.*

—**Savings made in purchasing** by having employees analyze their jobs and the costs of doing them. Detroit Edison makes purchasing department the agent of economy, rather than its point of origin—*p. 611.*

Photo-electric cell reads copy and sets type

N.E.L.A. Makes B. F. Weadock Managing Director

BERNARD F. WEADOCK, who in 1928 was engaged as special counsel by the Joint Committee of National Utility Associations to act in the Federal Trade Commission's investigation of electric and gas utilities, and who has since that time and up to the present ably represented utility interests in that inquiry, has just been appointed as managing director of the National Electric Light Association in succession to Paul S. Clapp, who resigned last



December. Mr. Weadock's appointment follows long and earnest consideration of possible appointees by the executive committee of the N.E.L.A. He was to take office on April 1 and will also continue his work before the Federal Trade Commission.

Mr. Weadock, whose connection with the power interests up to this time has been wholly that of legal adviser and defender, was born at Saginaw, Mich., in 1884 and, after two years' study at the University of Michigan, received an LL.B. from the Detroit Law College in 1905 and was admitted to the state bar. After serving as assistant corporation counsel of Detroit he entered private practice in that city, removing to New York City in 1929, where he became a member of the firm of Weadock & Wilkie.

▼

Massachusetts Senate Defeats Service Charge

On Tuesday of this week the Massachusetts Senate defeated the bill prohibiting the imposition of a service charge by gas and electric companies by a vote of fifteen to seven. The bill was opposed by municipal lighting plants as well as by private companies.

▼

Plan Negotiation at Fresno to Readjust New Rates

Following protracted hearings before the California Railroad Commission, with oral arguments closing March 21, concerning rates for the San Joaquin Light & Power Corporation and the Midland Counties Public Service Corporation, the commission has announced a new policy to the effect that when it shall have reached a decision as to the total amount of reduction, if any, to be made, all participants in the dispute will be invited to attend a supplemental hearing at Fresno to discuss how rates shall be readjusted instead of leaving this to the commission's discretion.

There are three points on which there is a wide divergence in estimates presented respectively by the power companies, the irrigation districts and the Railroad Commission engineers. These points are the revenue from agricultural power sales, the basis of charges for power made by the Pacific Gas & Electric Company and Great Western Power Company to the subsidiary San Joaquin and Midland companies, and depreciation.

▼

Texas Court Passes Upon Rights of Fairbanks-Morse

An injunction has been issued by the United States District Court at Austin, Tex., restraining Fairbanks, Morse & Company from interfering with contracts held by the Texas Electric Service Company and the Texas Power & Light Company in the towns of Seymour and Commerce, respectively. The opinion, however, leaves Fairbanks, Morse & Company free to sell their municipal plants to Texas cities on whatever terms they see fit and does not interfere with the solicitation for business for municipal plants carried on by Fairbanks-Morse and by the municipalities.

In 1928 the two power companies obtained a similar injunction which the Circuit Court dissolved, principally on the ground that the contracts then involved were subject to termination on 30 days' notice. After that reversal the power companies signed up their customers on two-year contracts, which form the basis of the present suit. Fairbanks, Morse & Company assume the position that they are breaking a virtual monopoly in about 75 towns.

▼

Utility Tax's Chances in Ohio Legislature

Governor White's proposal to the special revenue-raising session of the Ohio Legislature, now sitting at Columbus, that the tax on utility companies be raised from 1.35 per cent to 2.35 per cent is arousing interest in utility and political circles in that state. Last year, at the regular session, a bill to increase the tax to 4 per cent was left in committee after strenuous efforts to bring it on the floor. It is pointed out that more than half the votes against considering the excise tax increase during the regular session came from members elected from the same large cities—Cleveland, Cincinnati, Toledo, Youngstown, Columbus and Akron—which are most in need of relief funds now and which brought the most pressure to bear in favor of the special session. This fact is thought to presage a possible change of attitude on the part of urban lawmakers.

▼

Industry's Attitude on Tax One of Watchful Waiting

Smashing defeat by an insurgent House of Representatives of that provision of the bipartisan revenue measure which imposed a 2¼ per cent tax on manufactures, including electrical energy, removes an impending burden on the electrical industry which utility men have estimated all the way up to $45,000,000, although the indefinite phraseology of the proposed enactment and the opportunities it seemed to afford for legal argument over its interpretation have made it impossible to arrive at any approximation to absolute figures.

However, those who think that the electrical industry should not be asked to shoulder any taxes in excess of the heavy ones it now bears are not exulting. There still remains a possibility that the House will, under pressure or pleading, retrace its steps and pass the measure and a further possibility that, failing this, it may sanction the 7 per cent tax on domestic consumption originally proposed by the Secretary of the Treasury or the 5 per cent sales tax on all electricity first suggested by Representative Crisp, acting chairman of the ways and means committee. Furthermore, when the House gets through the Senate will begin. So that in the matter of federal taxation the industry's attitude has become that of "watchful waiting."

Utilities Ask Continuance of U. S. Court Jurisdiction

Legislation denying utility companies recourse to the federal courts in rate cases would be discriminatory and would serve no useful purpose, the Senate judiciary committee was informed by utility representatives at a hearing recently. The committee has under consideration the bill of Senator Johnson of California to exempt from the jurisdiction of United States district courts all cases brought to restrain the orders of state utility commissions where there is a diversity of citizenship involved or on questions arising under the Fourteenth Amendment with reference to the taking of property without due process of law. The Johnson bill would permit the federal district courts to take jurisdiction if the rate structure would interefere with interstate commerce or if it appeared that the parties in the controversy had not been allowed a reasonable notice and hearing and that there was no efficient remedy at law or in equity in the state courts.

Representatives of utility companies said that out of a total of 142,704 formal cases only 108 had been appealed to the federal courts, whereas 1,389 were taken to the state courts. It was contended, moreover, that Congress already has provided in the judicial code a method by which a state can prevent the submission of an appeal from its utility commission to the federal courts if it is demonstrated that the suit is being prosecuted in the state courts in good faith. Few states have availed themselves of this opportunity by enacting the necessary legislation. The complaint was also made that the Johnson bill, if enacted, would force complete determination of all rate proceedings through the state courts before an appeal could be taken to the United States Supreme Court, with consequent delay.

▼

Merger of Separated and Unlike Utilities Denied

Petitions for approval of the sale of the Patchogue Electric Light Company, which serves a portion of Suffolk County, Long Island, to the New York State Electric & Gas Corporation have been denied by the New York Public Service Commission. No reasons were given why the proposed merger would benefit the petitioners or would be in the public interest, the commission said, and no advantage could be seen by the commission in transferring the ownership and management of properties on Long Island to a company whose principal office is far upstate. Such a situation, it held, would introduce all of the unfavorable elements of absentee ownership and management.

"The territory of the Patchogue company is quite different from the average territory now served by the New York State Electric & Gas Corporation," Chairman Maltbie said, "and in dealing with questions of rates and service these differences must necessarily be taken into account. It would be extremely difficult to secure a segregation of costs for the Patchogue area if merger were permitted, thus greatly increasing the difficulties of regulation."

▼

Winnipeg's Negotiations for Utilities Dropped?

Negotiations for sale of the Winnipeg Electric Company's gas, electric and street railway utilities to the city are said to have been dropped. The company was asking $25,000,000 for the three utilities. The Winnipeg Electric has for the present almost ceased to operate the new Seven Sisters hydro-electric plant on the Winnipeg River as a result of the recent closing down by the Abitibi Power & Paper Company of the Manitoba paper mill at Pine Falls, which used 60,000 hp. daily.

▼

Dnieper Hydro Will Soon Serve Surrounding Plants

Seven industrial units are, according to a recent report from Russia, to be grouped about the Dnieper River hydro-electric plant and waterway and to be served from the nine 84,000-hp. hydro generators backed by 200,000 hp. in reserve steam capacity. These industrial units are a coke plant, a metallurgical plant, a ferro-alloy plant, an aluminum plant, firebrick yards, plants for slag-cement products and a machine repair plant.

The industrial enterprises have been planned with due consideration of the amount of power that will be available during the high-water and low-water periods of the river. During low water only three of the turbines can be operated. The seasonal power available with high water will be used to make ferro-manganese and for irrigation. When the hydro station is working at full capacity the steam plants can be shut down and overhauled. The schedule of completion of this 200,000,000-rouble plant was given as follows: March, 1932, two turbines (recent photographs of the plant, however, do not bear out the idea of its having reached this stage); May, two; August, one; September, one; November, one; January, 1933, one; March, 1933, one.

The ferro-manganese plant, designed for 80,000 tons a year, will be equipped with six single-phase furnaces of 10,000 kw. capacity each, and the ferro-silicon plant (20,000 tons) with three. Smaller furnaces will serve the ferro-chromium (4,000 tons) and ferro-tungsten (1,600 tons) plants. The annual capacity of the coke plant is set at 1,300,000 to 1,875,000 tons of metallurgical coke and 100,000 tons of smaller-sized; the steel plant is to produce 1,250,000 tons and will include three electric furnaces for making special steels, and the aluminum plant, with three units devoted respectively to aluminum oxide, electrolysis and electrodes, will have an annual capacity of 20,000 tons.

Car Loadings Reach New High for Year

UNCERTAINTIES over balancing the Federal budget and tax matters in general remain the principal disquieting factors in business. Financial circles are deeply concerned over possible further liquidation which they believe would follow passage of the Glass bill.

A further sharp dip in circulation figures is interpreted in Washington as evidence of a material decline in hoarding.

Moderate strength in basic commodity prices with the exception of cotton, which broke sharply this week, is encouraging. At the same time steel operations have contracted further, dropping to 24 per cent of capacity.

Car loadings increased slightly to a new high for the year, with miscellaneous and less-than-a-carload freight advancing 15,500 cars, indicating a definite increase in industrial activity.

▼

Roosevelt Veto Forbids Utilities to Manufacture

Governor Roosevelt of New York has vetoed the Dunkel bill amending the transportation corporations law in relation to powers of gas corporations. The bill sought to legalize the manufacture and sale of appliances by gas or gas and electric corporations. In vetoing the bill Governor Roosevelt said:

"The chairman of the Public Service Commission writes as follows: 'In my opinion, the act is entirely too broad, as it authorizes such corporations not only to sell or lease but also to make, and I see no reason why any utilities should be allowed to go into the manufacture of appliances and equipment.' Furthermore, this bill would definitely put gas and electric companies directly into the business of manufacturing gas and electric machinery apparatus and equipment. I raise the broad question of public policy as to whether a utility company should also be an industrial manufacturing company."

Putting a State Back on the Power Lines

Thirty hours after Alabama storm broke service everywhere was restored by power company's crews.

Sylacauga, Tuscaloosa and Demopolis suffer heavily.

DEVASTATION wrought to the transmission and distribution system of the Alabama Power Company by the tornado of March 21, briefly described in last week's issue, becomes more apparent as the work of repairing the damage proceeds. It will take from three to four months to put the system back in as good condition as it was before the storm struck with dramatic suddenness, leaving more than 300 dead, 2,500 wounded and property damage estimated at $7,000,000. The loss to the power company is officially estimated at about $50,000.

The completeness with which the twister swept down transmission lines in Alabama is illustrated in the case of Birmingham. The city is in the center of a "power loop" and is served by a group of hydro-electric plants. But it was cut off from hydro connections to the south and two strong tie-ins with the Georgia system.

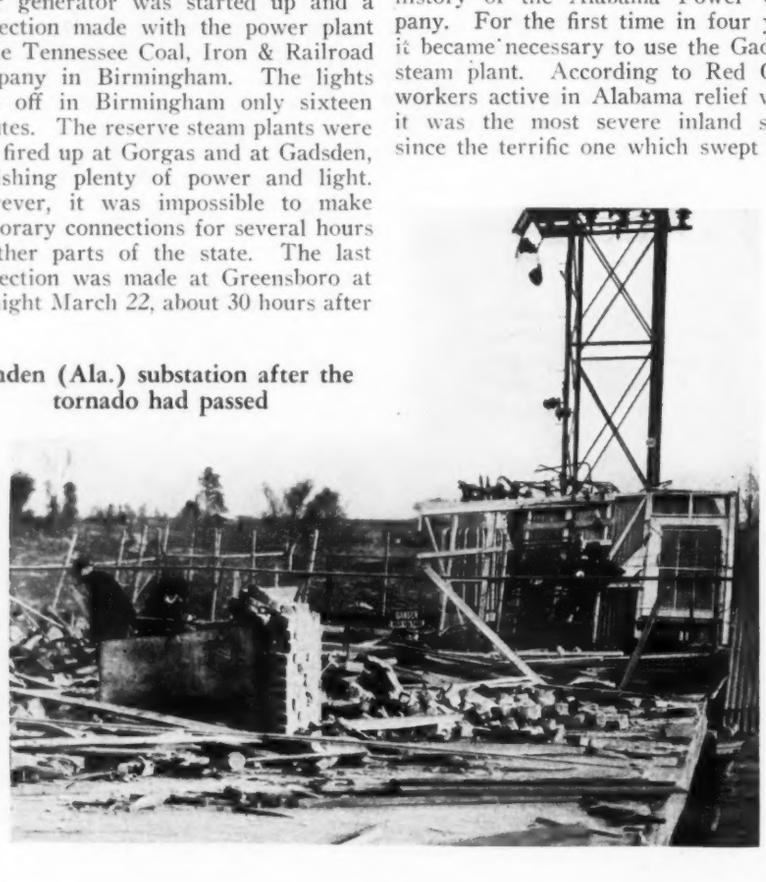
This disruption left intact only one connection with a hydro plant, at Muscle Shoals. It was insufficient to pull the Birmingham district load until another generator was started up and a connection made with the power plant of the Tennessee Coal, Iron & Railroad Company in Birmingham. The lights were off in Birmingham only sixteen minutes. The reserve steam plants were then fired up at Gorgas and at Gadsden, furnishing plenty of power and light. However, it was impossible to make temporary connections for several hours in other parts of the state. The last connection was made at Greensboro at midnight March 22, about 30 hours after the storm first burst over the state.

The work of restoring service was difficult on account of the wide territory in which disruptions came. As soon as the storm struck at 4:15 o'clock in the afternoon operating and construction workers were called out and materials rushed from the company warehouses nearest to the trouble points. Some of the men got on the job before the rain and wind ceased. The last town to be hit was Sylacauga at 7:06 o'clock. Trouble shooters of the company began nearest to their headquarters repairing damages and worked on down the line. When the Mobile crew wound up it found itself at Sylacauga, about 250 miles away. The company was able to restore service with its own crews with a few exceptions where extra men were employed. Damage to the lines included the blowing down of 70 steel towers and 20 wooden towers, all a part of 110,000-volt transmission systems. Between 25 and 30 towns were hit and the damage to their distributing system was tremendous. The substation at Linden, Ala., was completely demolished. One of the worst hit towns was Sylacauga, which has a municipally owned distributing system. Tuscaloosa, Clanton and Demopolis were among the cities where the electrica' damage was the greatest.

The tornado was the worst in the history of the Alabama Power Company. For the first time in four years it became necessary to use the Gadsden steam plant. According to Red Cross workers active in Alabama relief work, it was the most severe inland storm since the terrific one which swept Missouri, Illinois and Indiana on March 18, 1925.

A second storm on Sunday, March 27, although less devastating, covered additional territory in Alabama, Georgia, Tennessee and Mississippi, causing considerable damage to power lines and equipment. The tornado struck in the same spot near Clanton, Ala., where a week earlier it exacted a heavy toll in lives and property lost. Several transmission lines only temporarily connected after the first twister were again put out of commission, but service was soon restored.

Linden (Ala.) substation after the tornado had passed



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Lighting, Heating and Merchandising Are Coast Topics

A comprehensive highway lighting program was put before the Commercial Section of the Pacific Coast Electrical Association when it met at Santa Cruz, Calif., recently, by W. P. Bear of the Pacific Gas & Electric Company. His committee recommended that a 50-mile demonstration installation be undertaken by the industry at a cost of $130,000. He foresaw profits in the 2,500 miles that would follow tangible proof of what highway lighting might become.

Assemblyman B. B. Snyder spoke on public utility merchandising from the aspect of state government and deplored the tendency to ask for laws on matters which should be settled as questions of policy.

Air heating in its general aspects was discussed by H. H. Douglas of the Southern California Edison Company and others. Mr. Douglas cited as a successful instance of electric heat applied to buildings the Edison company's structure in Los Angeles, which, he said, had consumed only 20 per cent of the estimated kilowatt-hours for the past year. He attributed this efficiency to what he called the application or utilization factor, which means that electric heat can be applied just exactly where, when and for as long as wanted without waste. Another notable installation, he said, was the Sunset Tower Apartment with a 2,000-kw. load which was served by one 300-kw. transformer and through a very cold winter had never exceeded 230 kw. demand. It is thermostatically operated throughout. The load factor averages 35 per cent.

George C. Tenney, editor *Electrical West;* Leo Gianini, General Electric Company, and Frank Weiss, Los Angeles Gas & Electric Corporation, took part in a broad discussion of lighting in its relation to the power company, and W. A. Cyr, associate editor *Electrical West,* talked on wiring in its national aspects.

Trade Commission Digs in Arkansas and Mississippi

Intangible items such as discounts, premiums and commissions and other such outgoes incident to the organization and consolidation of the properties making up the Arkansas Power & Light Company were capitalized on the books of the new company for approximately $3,300,000, according to Examiner Charles R. Taylor, who testified last week in the Federal Trade Commission's utility inquiry. The Southwestern subsidiaries of the Electric Power & Light Corporation, affiliate of the Electric Bond & Share Company, were under examination. The sum just noted constituted more than 20 per cent of the original fixed capital of the Arkansas company, which represented an appreciation of $3,140,364 exclusive of the intangible items referred to.

Mr. Taylor explained that the properties of the Arkansas company were acquired together with other properties in Louisiana and Mississippi in "basket form" by Electric Power & Light from various sources and that the combined cost of all these properties was $52,425,920. Following the acquisition, the corporation proceeded to consolidate the companies according to states. Approximately 38 per cent, or more than $6,000,000, of the fixed capital and investments in affiliated companies recorded by the Mississippi Power & Light Company on its reorganization in 1927 was "appreciation," Mr. Taylor said, items of an intangible nature amounting to $1,445,506 not included.

Harry H. Carter, another commission examiner, gave detailed technical testimony on export of power between Arkansas, Louisiana and Mississippi by the Arkansas and Mississippi companies and the Louisiana Power & Light Company. The financial structure of the Louisiana company was not examined in detail.

On March 24 the commission, without leaving Arkansas, shifted from Bond & Share to Middle West interests and heard about the unsuccessful efforts of the Arkansas-Missouri Power Company to acquire the Jonesboro municipal electric plant. F. H. Watson, a Jonesboro broker, told of organizing a "property owners' league" to promote the sale and said the company paid him approximately $6,000 for his efforts, but that he spent more than this for expenses. An informal offer of $1,200,000 was, he testified, made for the city's plant, and he stood to collect a commission of $50,000 had the plan succeeded. Efforts were made, the witness said, to buy the support of a local paper, but they failed.

The commission then adjourned until April 5, when affairs of the Georgia Power & Light Company of Valdosta, Ga., an operating subsidiary in the Middle West Utilities Company chain, will be examined.

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Florida Cities Contest Utility Tax Law of 1931

The constitutionality of the tax law enacted by Florida last year which levies a tax of 1½ per cent on the gross revenues of all utilities, including those municipally owned, from the sale of electricity and gas and for telephone and telegraph service is being contested by the cities of Lakeland, Jacksonville, Orlando, Bartow, Fort Meade, Clearwater and Leesburg. The cities claim that the impost is an income tax and therefore unconstitutional in Florida, that the title to the act is defective and violative of the state constitution, that the law cannot apply to municipal corporations, since municipal property is exempt from taxation, and that the whole act is "ambiguous, indefinite, uncertain, unreasonable and confiscatory."

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Substation Trouble Brings Shutdown at New Haven

Total outage of service to New Haven, Conn., and outlying districts was caused late in the afternoon of March 23 when two 5,000-kva. transformers in a substation burned out. The Grand Avenue generating station bus failed to clear the trouble and a shutdown was inevitable. Service was restored to the downtown area in about an hour and in the suburbs by 11:30 p.m. Investigations by the United Illuminating Company and the Public Utilities Commission have been under way. The city is not interconnected with other systems.

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Harding Street Station Shut Down by Oil Fire

Leaking oil ignited by contact with exterior surfaces of steam-chest piping containing high-pressure steam at more than 700 deg. F. caused a fire affecting one of the two 35,000-kw. turbines of the new Harding Street station of the Indianapolis Power & Light Company soon after midnight on Tuesday, March 15. The operator shut the unit down and, the other unit not being in operation, the station was forced off the line. During the stopping period of about twenty minutes, with full excitation on the generator field, the leak continued to pour out oil, which saturated the magnesia coverings of the steam chest and piping and flowed down upon the floor.

This oil kept on burning after the machine had come to rest, and it was not until about 3 o'clock in the morning that the blaze was extinguished by the combined efforts of station attendants and the Indianapolis fire department. The station load was picked up by two older plants of the company and through the interconnected network which ties Indianapolis in with Louisville, Cincinnati, Terre Haute and Chicago.

Damage to the valve-operating relays and other steam-chest parts, as well as to the building itself, resulted from the fire. The tiled walls and floors of the plant were covered with about ⅛ in. of oil soot. The steam chest is somewhat remote from the turbine itself, and on this account damage to the turbine and generator was small. Although the second unit was available for service, the station was not back on the line until Wednesday. It is not thought that the damaged unit will be out of service long, since no extensive repairs are necessary.

Coming Meetings

Maryland Utilities Association — Lord Baltimore Hotel, Baltimore, April 8, D. E. Kinnear, 803 Court Square Bldg., Baltimore.

New England Division, N.E.L.A. — Safety conference, Boston, April 8. Miss O. A. Bursiel, 20 Providence St., Boston.

Great Lakes Division, N.E.L.A.—Engineering Section, Sherman Hotel, Chicago, April 13 and 14. R. G. Walter, Wisconsin Power & Light Co., Madison, Wis.

Northwest Electric Light and Power Association — Engineering Section, Heathman Hotel, Portland, April 13-15; H. H. Schoolfield, Pacific Power & Light Company, Portland. Accounting Section, Davenport Hotel, Spokane, Wash., April 18-19; W. F. Miller, Washington Water Power Company, Spokane.

Electrochemical Society — Lord Baltimore Hotel, Baltimore, April 21-23. C. G. Fink, Columbia University, New York.

Southwestern Division, N.E.L.A. — Arlington Hotel, Hot Springs, Ark., April 26 and 27. S. J. Ballinger, San Antonio Public Service Co., San Antonio.

American Welding Society—New York, April 27-29. M. Kelly, 29 West 39th St., New York.

Missouri Association of Public Utilities—Excelsior Springs, Mo., April 28-30. Jesse Blythe, 103 West High St., Jefferson City, Mo.

American Institute of Electrical Engineers—District meeting, Providence, May 4-7; summer convention, Cleveland, June 20-24. Acting secretary, 33 West 39th St., New York.

Middle West Division, N.E.L.A. — Muehlebach Hotel, Kansas City, Mo., May 18-20. Thorne Browne, 1527 Sharp Bldg., Lincoln, Neb.

East Central Division, N.E.L.A.—Commodore Perry Hotel, Toledo, Ohio, May 24-27. D. L. Gaskill, 603 Broadway, Greenville, Ohio.

National Electric Light Association — Atlantic City, N. J., June 6-10. A. J. Marshall, 420 Lexington Ave., New York.

Pacific Coast Electrical Association—Hotel Huntington, Pasadena, Calif. June 14-17. K. I. Dazey, 447 Sutter St., San Francisco.

Canadian Electrical Association—Manor Richelieu, Murray Bay, Que., June 15-17. B. C. Fairchild, 409 Power Bldg., Montreal.

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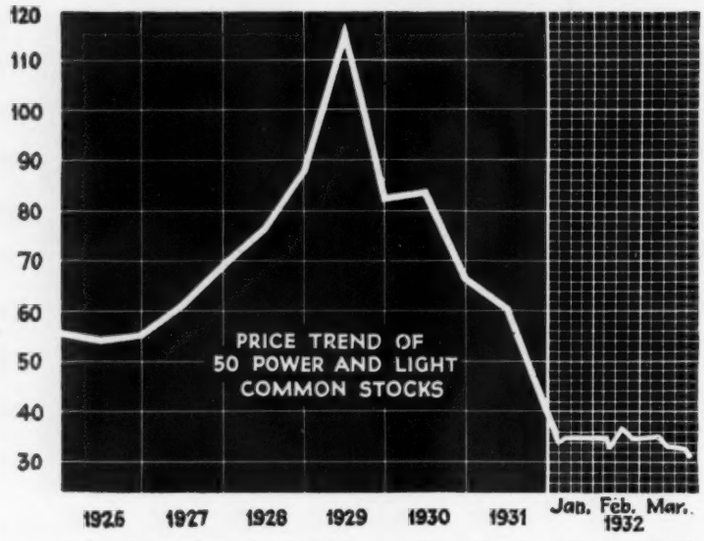
Bonds Firm; Stocks Down



As a result of continued uncertainty over the tax situation brokers generally hesitate to recommend further commitments for the present. The steadiness of the bond market is regarded as the most favorable factor in the market situation.

Name of Company	Amount of Issue (Par Value)	Period (Years)	Class
Duquesne Light Co.	$5,000,000	25	First mortgage gold bonds
Blackstone Valley Gas & Electric Co.	2,000,000	20	Mortgage and collateral trust gold bonds, series B
Virginia Electric & Power Co.	4,000,000	10	Secured convertible gold bonds
Syracuse Lighting Co.	5,000,000	25	First and refunding mortgage gold bonds, series B
Utica Gas & Electric Co.	2,000,000	20	General mortgage gold bonds, series E
Virginia Public Service Co.	2,000,000	20	First mortgage and refunding gold bonds, series C
Southern California Edison Co., Ltd.	10,000,000	22	Refunding mortgage gold bonds
Pennsylvania Power Co.	2,500,000	24	First mortgage gold bonds
Public Service Co. of Indiana	7,500,000	20	First mortgage and refunding bonds, series G
Total	$40,000,000		
Total amount actually realized	36,925,000		

Purpose	Interest Rate	Price	Per Cent Yield
Additions and extensions and for other corporate purposes	4½	92	5.06
To retire maturing obligations and for other corporate purposes	5	91⅞	5.69
To retire floating debt incurred for construction	5½	95½	6.10
To repay certain short-term indebtedness	5	95	5.35
To repay certain short-term indebtedness	5	93	5.55
To reimburse for expenditures on additions	6	78	8.25
To reimburse for expenditures on additions and for retirements	5	96	5.30
To reimburse for additions	5	95	5.35
To retire unfunded debt	6	87	7.25
Rights	66,808		
Total financing	$36,991,808		

To Adjust Capital of American Superpower

Shareholders of the American Superpower Corporation will vote on a proposal to reduce the stated value of the preference shares of that company from $100 to $1 each at the annual meeting on April 15 next. This action is necessitated, according to the letter received by holders, because of legal restrictions which would prevent the continuance of dividends were such steps not taken.

American Superpower holders are told that under the law of Delaware no dividends may be declared by any corporation unless the net assets of that corporation are in excess of the aggregate stated value of stocks having a preference upon the distribution of assets.

Approval on the part of stockholders would result in adding the difference of approximately $23,285,000 between the new stated value and the old to capital surplus. The value of the preference shares in liquidation will continue to remain $100 per share.

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New York Metal Prices

	March 23, 1932 Cents per Pound	March 30, 1932 Cents per Pound
Copper, electrolytic	6	6
Lead, Am. S. & R. price	3.00	3.00
Antimony	6.125	6.125
Nickel, ingot	35.00	35.00
Zinc, spots	3.25	3.15
Tin, Straits	21.85	21.20
Aluminum, 99 per cent.	23.30	23.30

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New Utility Offerings Total $40,000,000

During March new security offerings of electric light and power companies of the country totaled $40,000,000 as compared with $26,500,000 in February and $58,070,000 in March, 1931. Nine separate issues appeared, all in the form of mortgage bonds. The largest in-

dividual loan was raised by the Southern California Edison Company, a piece of financing involving a total of $10,000,000. Yields ranged from 5.06 to 8.25 per cent. Attention is called to the activity of refunding operations.

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Insull Companies Provide for Capital Needs

Much speculation has existed recently concerning a predicted corporate change in the Middle West Utilities system and also as to how refunding would be taken care of. The stockholders at their annual meeting held this week approved an amendment to the certificate of incorporation modifying the pre-emptive rights of common-stock holders.

All that the amendment really provides is that without first offering new common stock to stockholders the directors may issue any such shares now or hereafter authorized in payment for property or services, or in exchange for any outstanding stock having preference over common stock or any funded debt of the company. Directors may also issue securities convertible into common stock and may give rights or option warrants without first offering them to the stockholders.

Referring to a previous suggestion that certain properties might be sold, Samuel Insull intimated that such properties, if any, would be smaller Eastern properties not "geographically" part of the system. Much-discussed refinancing needs of the Insull companies are taken care of, at least in so far as Commonwealth Edison, Public Service Company of Northern Illinois and People's Gas Light & Coke Company are concerned. This information was given out by Samuel Insull recently. He stated that there would be a substantial surplus after dividends in the case of all three companies. In respect to the Commonwealth Edison Company Mr. Insull said:

> Notes of that company to the amount of $20,000,000, all the financing it has to do this year, will fall due on July 30. Well, we had $20,108,738 in cash in the banks last Friday morning. Under ordinary circumstances we would hardly be thinking about our financing at all this far in advance of our needs. But, because times are unusual, we have already given it careful consideration and feel that we have the matter in hand for all these companies.

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Receivership Is Asked for Insull Trust

Appointment of a receiver for Insull Utility Investments, Inc., and dissolution of the trust was asked in a bill filed March 30 in the Cook County (Ill.) Circuit Court on behalf of Mrs. Helen Samuels of Chicago, owner of four of the company's $1,000 debenture notes. The company is an investment trust organized in 1929 by the Insull interests. The bill charges that the company lacks funds to pay off obligations, consisting of bank loans, bonds and other liabilities.

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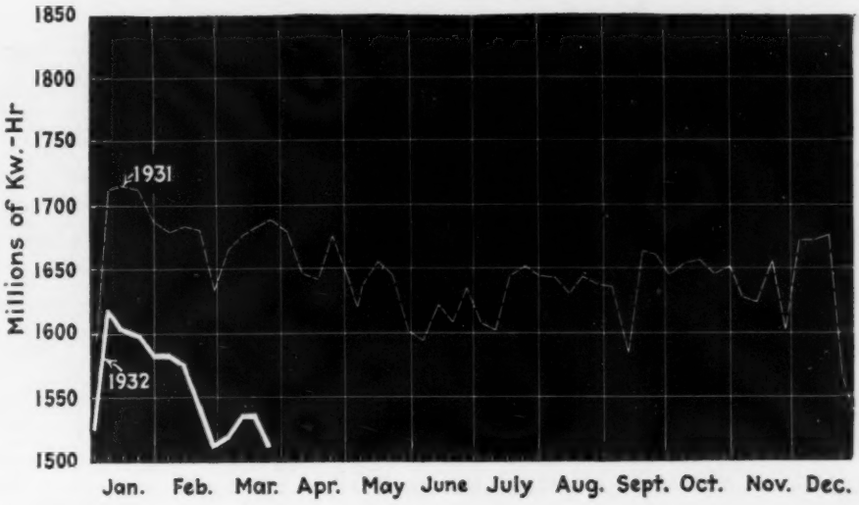
Allis-Chalmers Net Income Down 65 per Cent

Net income of the Allis-Chalmers Manufacturing Company for 1931 after all charges was $1,256,431, in comparison with $3,604,609 in 1930. Bookings for the year totaled $22,687,048, in comparison with $41,606,196 in 1930. Billings totaled $27,800,638, in comparison with $41,475,949 in 1930. Unfilled orders at the end of 1931 amounted to $7,889,333, in comparison with $13,002,923 a year previous. The consolidated balance sheet showed assets at the end of 1931 of $75,369,332, in comparison with $74,645,986 at the end of 1930. The earned surplus at the end of the year amounted to $16,840,313, in comparison with $17,399,110 at the end of 1930.

Week's Output Slightly Smaller



CONTRASTING against a rise at this time last year, the energy production of electric light and power plants decreased somewhat in the week ended March 26 compared with the preceding week. Consequently the shrinkage from 1931 is unusually large; it amounts to 10.3 per cent. It should be stated that the increase during March last year was contrary to the normal seasonal movement, which is downward.

Changes in the East were moderate, though tending to widen the disparity between the two years. It will be recalled that industrial activity increased in this section last spring. Present power figures suggest a parallel movement now. On the Pacific Coast the downward movement continues, with 16.6 per cent less output than last year.

Weekly Output, Millions of Kw.-Hr.

	1932	1931	1930	1929
March 26	1,515	1,689	1,723	1,680
March 19	1,538	1,682	1,722	1,683
March 12	1,538	1,676	1,736	1,687
March 5	1,520	1,664	1,750	1,703
February 27	1,512	1,633	1,744	1,707

Per Cent Change from 1931

Region	Week Ended March 26	March 19	March 12
Atlantic seaboard	— 4.7	— 3.2	— 3.1
New England alone	— 4.3	— 4.6	— 3.9
Central industrial	—13.9	—12.4	—11.1
Chicago district	— 9.8	— 8.9	— 4.5
Pacific coast	—16.6	—14.2	—12.1
United States	—10.3	— 8.6	— 8.2

Federal Regulation Looms, Prendergast Declares

Lecturing on public utility regulation at Union College, Schenectady, recently, William A. Prendergast of New York City, former chairman of the State Public Service Commission, said that the failure of states to deal adequately with holding companies was compelling the federal government to take a hand and that this would end in federal regulation of operating utilities controlled by the holding companies.

Stating that "a conviction is gaining ground that the holding company is a device for the exploitation of securities which look for their principal support to the rates for service paid by the consuming public," Mr. Prendergast continued:

> On one hand we find that the holding company through its ownership of the operating companies insures necessary financial help, more advanced technical advice, better prices in the purchase of supplies and the employment of the greater and more diversified experience in management and policy making. On the other hand, we find that the holding company, which has complete control of its operat-

Current Earnings Reports of Electric Light and Power Companies

OPERATING COMPANIES

	1931	1930	Per Cent Increase	Operating Ratio 1931	Operating Ratio 1930
Edison Electric Illuminating of Boston (Year ended December 31)					
Gross earnings	$30,815,429	$30,617,180	0.6	41	42
Net earnings	18,027,298	17,680,065	1.9	..	..
Hartford Electric Light (Year ended December 31)					
Gross earnings	7,204,867	7 387,123	— 2.4	57	57
Net earnings	3,101,213	3,138,392	— 2.0	..	..
Kansas Gas & Electric (Year ended December 31)					
Gross earnings	5,644,717	5,952,519	— 5.0	51	50
Net earnings	2,772,247	2,933,766	— 6.0	..	..
Oklahoma Gas & Electric (Year ended December 31)					
Gross earnings	11,887,260	14,230,497	—16.5	50	53
Net earnings	6,030,605	6,663,188	— 9.5	..	..
Philadelphia Electric (Year ended December 31)					
Gross earnings	66,318,437	65,792,118	0.8	54	54
Net earnings	30,598,281	30,471,958	0.4	..	..
Wisconsin Public Service (Year ended December 31)					
Gross earnings	5,514,448	5,592,331	— 1.4	56	59
Net earnings	2,399,968	2,313,847	3.7	..	..
	1932	1931		1932	1931
Arkansas Power & Light (Year ended January 31)					
Gross earnings	8,144,437	8,717,249	— 7.0	50	55
Net earnings	4,038,908	3,951,060	2.0	..	..
Birmingham Electric (Year ended January 31)					
Gross earnings	7,250,331	8,144,629	—11.0	69	70
Net earnings	2,219,887	2,518,046	—12.0	..	..
Carolina Power & Light (Year ended January 31)					
Gross earnings	9,755,160	8,966,012	9.0	50	45
Net earnings	4,863,559	4,955,285	— 2.0	..	..
Detroit Edison (Year ended Feb. 29)					
Gross earnings	48,636 268	52,535,685*	— 7.4	65	68
Net earnings	17,213,429	16 792,237*	2.5	..	..
Houston Lighting & Power (Year ended January 31)					
Gross earnings	8,569,498	8,785,770	— 2.0	46	52
Net earnings	4,642,450	4,209,847	10.0	..	..
Kansas Gas & Electric (Year ended January 31)					
Gross earnings	5,623,822	5,944,961	— 5.0	50	51
Net earnings	2,779,266	2,923,523	— 5.0	..	..
Louisiana Power & Light (Year ended January 31)					
Gross earnings	6,079,085	6,182,086	— 2.0	50	52
Net earnings	3,038,748	2,948,436	3.0	..	..
Memphis Power & Light (Year ended January 31)					
Gross earnings	6,780,990	6,896,458	— 2.0	58	59
Net earnings	2,854,019	2,823,554	1.0	..	..
Minnesota Power & Light (Year ended January 31)					
Gross earnings	6,029,258	6,490,332	— 7.0	37	38
Net earnings	3,791,025	4,024,407	— 6.0	..	..
Montana Power (Year ended January 31)					
Gross earnings	8,660,026	9,911,869	—13.0	40	40
Net earnings	5,170,777	5,917,990	—13.0	..	..

OPERATING COMPANIES

	1932	1931	Per Cent Increase	Operating Ratio 1932	Operating Ratio 1931
Nebraska Power (Year ended January 31)					
Gross earnings	6,802,351	6,647,795	2.0	47	49
Net earnings	3,595,051	3,391,263	6.0	..	..
New Orleans Public Service (Year ended January 31)					
Gross earnings	17,094,850	17,774,847	— 4.0	63	64
Net earnings	6,291,821	6,331,805	— 1.0	..	..
Pacific Power & Light (Year ended January 31)					
Gross earnings	4,495,615	4,478,409	0.0	52	52
Net earnings	2,128,214	2,156,015	— 1.0	..	..
Pennsylvania Power & Light (Year ended January 31)					
Gross earnings	34,885,499	31,416,465	11.0	48	50
Net earnings	18,074,710	15,815,343	14.0	..	..
Texas Electric Service (Year ended January 31)					
Gross earnings	8,202,277	9,080,679	—10.0	47	48
Net earnings	4,342,098	4,677,800	— 7.0	..	..
Texas Power & Light (Year ended January 31)					
Gross earnings	9,965,282	9,948,647	0.0	48	49
Net earnings	5,148,676	5,062,573	2.0	..	..
Utah Power & Light (Year ended January 31)					
Gross earnings	10,557,541	11,160,487	— 5.0	48	45
Net earnings	5,555,986	6,117,744	— 9.0	..	..
Washington Water Power (Year ended January 31)					
Gross earnings	8,683,599	9,489,343	— 8.0	48	44
Net earnings	4,558,012	5,308,495	—14.0	..	..

HOLDING COMPANIES

	1931	1930		1931	1930
American Light & Traction & Subs. (Year ended December 31)					
Gross earnings	40,483,040	43,766,045	— 7.5	73	73
Net earnings	11,022,347	11,899,185	— 7.4	..	..
Federal Light & Traction & Subs. (Year ended December 31)					
Gross earnings	8,024,250	8,502,131	— 5.6	55	54
Net earnings	3,582,724	3,912,801	— 8.4	..	..
North American & Subs.† (Year ended December 31)					
Gross earnings	117,921,860	133,751,381	—11.9	53	52
Net earnings	55,129,122	63,912,941	—13.8	..	..
Philadelphia Company & Subs. (Year ended December 31)					
Gross earnings	56,036,779	61,521,044	— 8.91	50	51
Net earnings	28,240 073	29,988 827	— 5.83	..	..
	1932	1931		1932	1931
American Water Works & Electric & Subs. (Year ended January 31)					
Gross earnings	49,425,815	53,782,780	— 8.1	50	51
Net earnings	24,647,180	26,125,898	— 5.7	..	..

*Year ended February 28. †Former California subs. excluded for entire 12 mos. ended December 31, 1931 and for 6 mos. and 18 days ended December 31, 1930.

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ing subsidiaries, has become the actual (not the legal) operator of the operating companies that its legal control and policy-directing domination are absolute. Therefore, if operating utilities should be subject to regulation, as they are, why should not the real operator of these operating utilities be regulated?

The states have not met this question, possibly because they fear that they could not exercise sufficient control over holding companies, organized as many of them are in other states and being therefore in the category of "foreign corporations." But the fact is that no genuine effort has been made, especially in this state, to solve the problem.

The consequence of this laissez-faire policy on the part of the states has been to encourage the idea of federal legislation, which is now almost in the making. The danger of the latter possibility is that if Congress legislates to control the holding company it will slowly but surely embrace the operating companies. In this way another blow will be struck at state autonomy. This means more federal bureaucracy.

Mr. Prendergast suggested that a combination of federal and state jurisdiction might develop as the outcome and that public opinion would be "placated" by a willingness of the holding companies to meet the issue in "a co-operative spirit."

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Great Britain Appoints Electrical Ambassador

What appears to constitute a departure in state aid for overseas trade is initiated by Great Britain in the appointment of H. D. Sidderley as electrical ambassador to Argentina. Mr. Sidderley's appointment is sponsored by the British Electrical and Allied Manufacturers' Association, but it is assumed that government aid will be forthcoming. Apparently a government subsidy is to be paid to support an unofficial representative of a particular branch of industry in a particular market. Mr. Sidderley will be in Buenos Aires.

Under this new arrangement Mr. Sidderley, who is a commercial and technical expert, will be able to furnish at short notice every detail required by the prospective purchaser of electrical equipment of any kind. Considerable time and expense will now be saved in submitting quotations and tenders to the advantage of both contractor and buyer. Mr. Sidderley will act as a consultant and an intermediary in directions likely to assist the interests of British electrical manufacturers and with a view to augmenting the efforts made through existing channels by British firms. His principal function will be to maintain contact with government departments, public utility companies, railways, engineering institutions, etc., and between agents and representatives of the manufacturers in order to facilitate consultation when required.

General Electric Orders Down 26 per Cent

Complete figures now published for the operations of the General Electric Company during 1931 show a net profit available for dividends of $40,956,996, which is equivalent to $1.33 a share, against $57,490,915, or $1.90 a share, in 1930.

After the payment of a common stock dividend of $1.60 a share and the 60-cent dividend on special stock for 1931 there was a deficit of $7,768,266 charged to surplus, which at the end of the year amounted to $172,198,374.

Orders received by the company during the year amounted to $252,021,496, against $341,820,312 in 1930, a decrease of 26 per cent. Unfilled orders at the end of the year were $49,308,000, against $56,062,000 at the end of 1930, a 12 per cent decrease.

Sales bills for 1931 were $263,275,255, compared with $376,167,428, or 30 per cent decrease from 1930. Net income from sales after cost expenses and all charges except interest was $28,390,883, against $40,450,261 in the previous year.

The income accounts of the company for the two years compare as follows:

	1931	1930
Net sales billed	$263,275,255	$376,167,428
Less: Costs, exp. and all charges except interest	234,884,372	335,717,167
Net income from sales	$28,390,882	$40,450,261
Inc. from other sources: Asso. costs and misc. securities	8,657,110	13,453,654
Int. and discount	3,819,280	3,258,498
U. S. govt. and other marketable securities	21,533	1,757,715
Royal. and sun. rev.	501,422	1,605,334
	$12,999,346	$20,075,202
Total income	$41,390,229	$60,525,463
Less: Int. payments	$433,233	$313,078
Add. to gen. reserve	.....	2,721,470
Profit avail. for divds	$40,956,995	$57,490,915
Less: 6% cash divds. on special stock	2,575,005	2,574,952
Profit avail. for divds. on common stock	$38,381,990	$54,915,962
Less: Cash divds. on common stock	46,150,256	46,150,203
Deficit (1931) and surplus (1930) for year	$7,768,266	$8,765,758

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Third 33-Kv. Generator Being Built in Britain

A 20,000-kw., 33,000-volt generator is in process of construction in England at the Heaton Works of C. A. Parsons & Company, Ltd., for the Salt River power station, Cape Town, South Africa. This is the third 33,000-volt generator to be built. The first (Brimsdown) has now been in operation about 3½ years and it is said that in spite of some unusually severe operating conditions it has been entirely satisfactory to the user. The Cape Town machine will be similar to the second one to be installed (Derby). It will be driven by a single-cylinder duplex exhaust turbine designed for a steam pressure of 400 lb. per square inch and 750 deg. temperature.

The 50-cycle, 33,000-volt alternator, with a closed system of cooling and a direct coupled exciter, will produce 20,000 kw. at 0.80 power factor.

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Refrigeration Division Makes New Appointments

Recent activities of the refrigeration division of the National Electrical Manufacturers' Association include the following changes among others:

The Grigsby-Grunow Company has joined the division and is represented by Don M. Compton and W. G. Peirce, Jr.; C. D. Taylor of Westinghouse has resigned and is replaced by C. B. Graves of the same company; J. A. Harlan, vice-president of Frigidaire, has resigned and is replaced by H. W. Newell; the division chairman appointed Henri Brysselbout, Copeland; R. W. Sinks, Frigidaire, and R. S. Cosgrove, Westinghouse, to serve on the industrial research committee.

A code of ethics has been developed by the commercial practices committee and approved by the division. This code has been printed through the courtesy of the General Electric Company and made available in quantity to all division members.

Major New Construction This Week

TRANSFORMERS, substation equipment, motors and controls, machine-drive apparatus, conduits and wiring, conveyors, etc., costing close to $100,000, will be installed by Titanium Pigment Company, New York, in proposed plant near South Amboy, N. J. A $1,500,000 project.

Colorado Springs, Colo., proposes addition to steam-operated municipal power plant; turbo-generator and auxiliaries, to cost about $138,000; boilers and steam power accessories, $75,000.

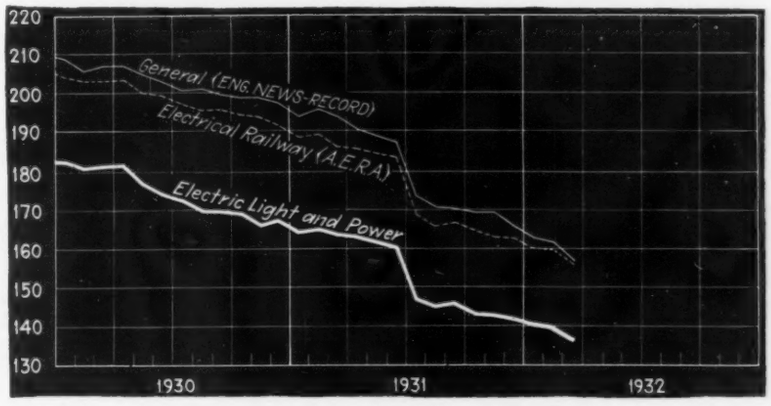
An $80,000 expansion and improvement program, including electrical equipment, is under way at Yellow Pine Paper Mill of Commercial Pulp & Paper Company, Orange, Tex.

Traveling coal crusher, complete soot and ash-handling system and other fuel-handling equipment asked for in bids closing April 12 by Board of Public Works, Fort Wayne, Ind., for improvements in city light and power station. Estimated cost $65,000.

Three generators, accessories, boilers, pumping machinery and electrically operated ice-making machinery will be purchased by State Board of Affairs, Oklahoma City, Okla. Estimated total $100,000.

Electric distributing system bids for Naval Air Station, Sunnyvale, Calif., are being asked until April 13 by Bureau of Yards and Docks, Washington D. C., including underground conduits, cables, transformers and concrete lighting standards. (Specification 6813).

Construction Costs Still Falling



FURTHER reduction in electric light and power construction costs is indicated by the index for March in the accompanying table. There has been a decrease of 2 per cent from February, about 4 per cent from January and 17 per cent from March, 1931. Thus the downward trend continues.

As might be expected, the changes in this class of construction costs are closely similar to those for electric railway and for general engineering construction. Index numbers for earlier years were published in the ELECTRICAL WORLD of February 13, 1932, on page 318.

Construction Cost Indices: Electric Light and Power, Electric Railway and General

Base 1913 = 100

	Electric Light and Power*	Electric Railway*	General—*Engineering News-Record*
March, 1932	136	156	157.2
February, 1932	139	159	161.8
January, 1932	141	161	162.5
March, 1931	164	187	194.5
Last 5 yrs' high	184	206	210.4
Month	Apr. '29	Nov. '28	Feb. '29
Last 5 yrs' low	136	156	157.2
Month	Mar. '32	Mar. '32	Mar. '32

*Computed by Albert S. Richey.

Power Association Helps Lawrence

Lawrence, Mass., one of the many cities with depleted treasuries, is to be helped by the New England Power Association, President F. D. Comerford of that organization having recommended to the Lawrence Gas & Electric Company, a subsidiary, that it pay the city $100,000 immediately, anticipating taxes not due until October.

▼

Indianapolis Rate Case Next Week

The proposal of the city of Indianapolis that a complete appraisal of the Indianapolis Power & Light Company be made before rate hearings are begun has been denied by the commission, which has ordered the utility officials to submit a reduced rate structure for suburban and rural patrons. This the company was already preparing. A hearing on the city's petition is to be held April 6.

▼

Power Board Case to Supreme Court

Argument was completed last week before the United States Supreme Court in the constitutional conflict between the Senate and the President involving the right of George Otis Smith to his post as chairman of the Federal Power Commission. Ex-Senator Pepper of Philadelphia supported Attorney-General Mitchell in the contention that the President was not obliged to return the nomination to the Senate on its request after Mr. Smith had once been confirmed by that body, and John W. Davis argued that precedent upheld the right of the Senate to recall its approval.

▼

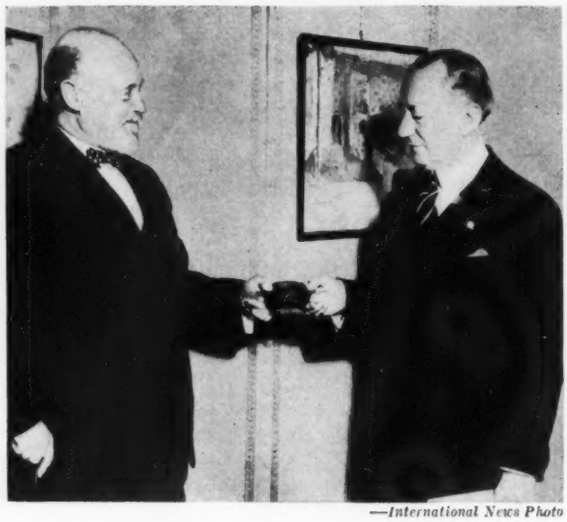
Lower Rates for Birmingham?

Domestic and commercial rates for electricity in Birmingham would be reduced approximately one-third under a revised schedule recommended by Chief Engineer McDonald of the Alabama Public Service Commission, following his investigation of the Birmingham Electric Company. The minimum rate for four rooms or less with electric refrigeration would be $2 a month, entitling the consumer to 20 kw.-hr. The present minimum is $3.

▼

Negotiating Farm Rates

Four hundred Wisconsin farmers met in Madison recently and appointed a committee to ask a revision of rural rates by the Wisconsin Power & Light Company. Six years ago a similar farmers' committee met the company and was instrumental in having the service charge reduced from $5.50 to $3. Vice-President Neff has agreed to negotiate again with the rural customers, who since 1926 have increased from 1,200 to nearly 10,000, and they will appoint an executive committee of five and an advisory committee of nineteen. Their executive committee will confer with the power company's representatives and will appear also before the Public Service Commission, which is conducting a state-wide investigation of the company's rate schedules.



—*International News Photo*

MARCONI ADDS A MEDAL TO HIS STRING

John W. Garrett, Ambassador from the United States to Italy, hands to Senator Marconi the gold medal which accompanied the John Scott prize awarded to the father of radio by Philadelphia.

▼

Hearing on White River Plan May 3

May 3 has been set by the Federal Power Commission for a public hearing on the request of the Empire District Electric Power Company that issuance of a license to permit it to proceed with its sixteen-million-dollar hydro-electric project at Table Rock, on the White River in Missouri, be postponed a year. The company holds that present conditions do not indicate any early demand for the power and that financing the scheme would be unreasonably expensive at this time.

▼

Duke Company Buys Two Plants

Electric properties of the National Gas & Electric Corporation at Marion, N. C., and Laurens, S. C., were sold last week to the Duke Power Company for a sum said to be about $500,000 in cash. They are in territory contiguous to that in which other Duke Power properties operate and consist mainly of two or three water-power plants with a total rating of 2,875 kva. at Laurens and a small hydro plant at Marion.

▼

Full Committee Accepts Shoals Bill

By a vote of thirteen to eight the military affairs committee of the House of Representatives has voted to report out the Muscle Shoals bill drafted by a subcommittee and summarized in the ELECTRICAL WORLD for March 19.

Permits for Snohomish District

Application for a preliminary permit for hydro development on the Sultan, Olney, Wallace and North and South Forks of the Skykomish River has been filed with the Federal Power Commission by the Great Northern Power Company. The company's comprehensive scheme calls for three plants and the ultimate expenditure of $8,000,000. The application is the second covering power development in Snohomish County, the Washington Electric Company, builder of the Rock Island project and subsidiary of the Puget Sound Power & Light Company, having applied for a permit in the Gold Bar district, where Lake Isobel would serve as site for a storage dam.

▼

Would Abolish "Extra" Charges

All public utility companies in Kansas have been requested by Thurman Hill, speaking for the Public Service Commission, to eliminate or reduce service or other "extra" charges by July 1 next and thus avoid rate investigations. Mr. Hill said also that the commission believed deposit charges required by utilities "excessive in view of present conditions" and that wherever possible they "should be reduced materially or entirely eliminated."

▼

High-Temperature Metals Research

Announcement is made by a joint research committee of the A.S.M.E. and the A.S.T.M. of the perfection of plans for sponsored researches during the year 1932 at the engineering experiment station of the University of Illinois, Urbana, and the Battelle Memorial Institute, Columbus, Ohio, on the effect of temperature on the properties of metals. The work at the university, under Prof. H. F. Moore, will relate largely to the endurance prop-

erties of austenitic nickel-chromium steels at different temperatures. This will be co-ordinated with creep tests at the Battelle Memorial Institute, under Dr. H. W. Gillett, as well as with studies at various industrial laboratories relating to the structural stability of these steels and the changes in various properties with time at high temperatures.

▼

New England Seeks Policies for Recovery

Wider application of scientific management, market analysis, plant betterments and sales-stimulating policies are favored in replies to a survey by the New England Council, whose results are now released as a cross-section of industrial thinking in the Northeast in the face of 1932's economic problems.

General business as represented by 853 concerns, eighteen electrical manufacturers and 33 public utilities answered the council's questionnaire. The preponderance of opinion favored cutting costs by other means than further salary reductions, striving to increase sales volume, reducing production expenses, keeping the government out of business and analyzing markets. The electrical manufacturers ran ahead of general business and industry in New England in championing new product development, concentrating on the most profitable lines and sales territories, increasing plant capacity and in encouraging research leading to the development of new products and improved methods. A strong trend toward more intensive sales development and market analysis was evident in the utility replies.

▼

M. I. T. Organizes New Plan for Engineering School

President Karl T. Compton of the Massachusetts Institute of Technology announced a new plan of administrative organization recently under which a school of engineering will be headed by Dr. Vannevar Bush as dean and vice-president of the Institute. Other divisions include schools of science, architecture, humanities and industrial co-operation. The last-named division is designed to bring about closer relations between the Institute and the world of business and industry. A graduate school has also been established.

The engineering school will include aeronautics, building construction, business and engineering administration, civil and sanitary, chemical, electrical, electrochemical, fuel and gas, general, mechanical, mining and metallurgical, naval architecture and marine engineering, and naval construction.

Unit Type Rural Station Proves Its Economies

A unit-type metal-clad substation consisting of a 750-kva. transformer, one feeder circuit breaker, disconnecting switch and control has recently been placed in operation by the Central Hudson Gas & Electric Corporation. This equipment, which follows closely the basic idea of the medium-voltage network unit with regulating transformer, developed by General Electric last year, permitted simplification of the breaker and control layout. The use of a low-duty oil circuit breaker allows for construction of an inexpensive unit comparable in cost with a small rural substation of ordinary exposed-type construction.

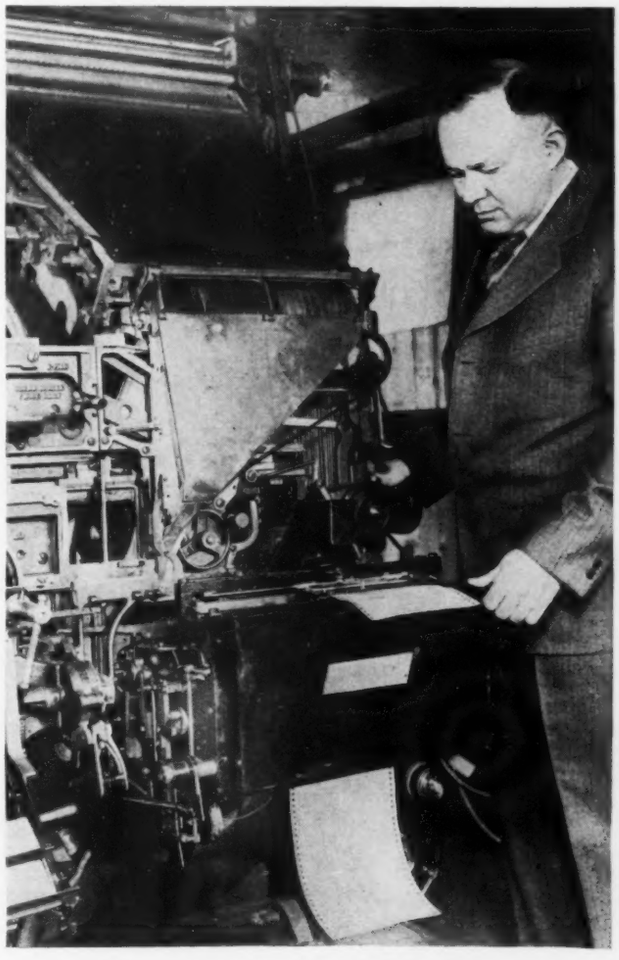
The complete station, installed at Washington Hollow, offers not only a distinct departure in present-day rural service practices but low installed cost, flexibility for moving to changing load centers easily and economically, voltage regulation which compensates for both transmission-line and primary-line drop, easy and safe maintenance, inconspicuous and pleasing appearance with a minimum public liability hazard, ready renewal and replacement of any piece of apparatus in case of breakdowns and opportunity to add feeder circuit breakers readily and economically as load conditions change.

▼

"Electric Eye" Operates Typesetting Machine

Operation of a linotype automatically by a device called a "semagraph," operated by a photo-electric cell, was demonstrated at Charlotte, N. C., on March 28 before a group of publishers and newspaper executives. The demonstration was given by the inventor, Buford L. Green, in the Charlotte *Observer* building, where for more than two years he has worked in secret to develop the device with the backing of the publisher of that newspaper.

Mr. Green placed a sheet of copy from a specially constructed typewriter on the carriage of his mechanism which replaces the standard linotype keyboard. A tiny beam of light was focused on the copy, at the left end of the first line. The switch was thrown and the carriage began to shuttle the copy to the left until the beam of light covered the entire line. Simultaneously the matrices began to drop from the linotype machine and the slug of type was cast just as it is in the ordinary machine.



The beam of light, Mr. Green explained, goes through the semitransparent copy paper and falls upon the photo-electric cell, which converts the light impulses to electric impulses, and these in turn release the proper matrices from the magazine. Each letter and symbol on the copy is represented by a combination of dots, ranging in number from one to six. The typewriter in printing the words at the same time prints the proper dot code under every letter. The device works entirely from the symbols. The typewriter is equipped with a special space bar, making each line of copy just the proper length to make a line of type of desired width.

EDITORIALS

L.W.W.MORROW
Editor

New purpose in the plans of the commercial men

LAST week's conference of N.E.L.A. Commercial Section committees in Chicago was the best meeting that this group has held for a long while. The representative men were there, and there was purpose in the program.

The refrigeration campaign has been under way for a year and is now taking hold in many cities that were slow to appreciate what it offers and to understand what to do. The drive is stronger than at any time in 1931. The range campaign is crystallizing rapidly and holds promise of another broad wave of co-ordinated selling for building the domestic load. It is backed by the National Electrical Manufacturers' Association as well as by the power industry. The residence lighting committee has issued a "challenge" and is in the market with a balanced plan looking forward over a term of years. This is all encouraging because it is deliberately constructive. For too many years N.E.L.A. commercial committees were content to make the product of the year a printed report. It was read and filed, or filed without reading, or thrown away. Little came of it, and the next committee thereupon proceeded to do it all again. Apparently the sales managers have now climbed up out of that old rut and are using their organization for more practical accomplishment.

Part of this springs from the more hopeful status of the power-company commercial manager himself. For many years the chief executives of the utility companies were simply not interested in the problems or operations of the sales staff. They would not be bothered with the policies and plans of the commercial department. But times have changed. Now the presidents and general managers are consciously leaning on the sales department and calling for more business. This has given the sales manager a recognition that he has not had before, and he is stepping out from under the old restraint.

Dim your lights and watch crime grow

SOME cities, striving to save a dollar, were recently led to reduce the standard of their street lighting, but in most if not all cases the scheme was quickly abandoned by unanimous consent. If any one was disappointed at the right-about-face, it was the footpad and the second-story worker. The citizens concluded that the hazard to traffic and to the safety of person and property was not worth the few cents per inhabitant that might be saved in a year.

Lansing, Mich., tried it for a little more than a week. The officials found that it would cost $7,000 to revamp the city's installation so that the same amount could be saved in a year of 70 per cent street lighting. But the real determining factor in dropping the plan was the prompt realization that crime thrives on darkness and abhors light. The safety factor was exemplified in Decatur, Ill., where a newspaper cited accidents on the stage of a theater and on the steps of a church and asserted confidently that these would not have happened had not false economy led to curtailment of local lighting.

Sprained angles, cracked skulls, snatched purses, looted homes and, far worse, the molestation of women are logically to be feared as the price to pay for reversion to primitive lighting. If anything, more light rather than less should be society's answer to the growing tendency toward

kidnapping and crimes of violence and larceny in a world saturated with economic distress and doubts about the efficacy of government to protect its citizens.

Bernard Arthur Behrend

IN THE untimely death of Dr. B. A. Behrend electrical engineering loses an outstanding figure in alternating-current machinery design. Endowed with a profound natural aptitude for studying the complexities of electromagnetism by mathematical analysis and trained in the thorough methods of German scientific education, this young Swiss engineer quickly acquired a reputation as a specialist following his arrival in this country more than a third of a century ago. Desirable and long-continued connections were the fruit of his ability; later his responsibilities embodied executive engineering in the Allis-Chalmers organization, and his years at Boston as a consultant added to his distinction.

Behrend's contributions to electrical machinery development were numerous and valuable, including advanced conceptions of core-and-slot design, the advocacy of high peripheral speeds for hydro-alternators, analyses of regulation, and others. His sense of intangible values in engineering partook of poetic genius. Comparatively unknown though he was to the public, he was a savant of applied science whose passing leaves the world better for his having served it to the full extent of his rare talents.

Away with engineering patchwork!

UNDER present conditions there are few reasons for adopting stop-gap methods of electrical maintenance. Since construction and material costs are more favorable today than for a long time, operating companies which take advantage of their opportunities will reap an enduring reward in the shape of relatively lower fixed charges on present available equipment. Nay, more; service quality goes hand in hand with current high-grade designs of apparatus and their sound application in the field.

Good management refuses to countenance unwise attempts to keep superannuated distribution transformers in service by shifting them around in the face of overdue obsolescence, to patch up fuel-handling equipment with "kink" fittings, to strain outworn auxiliary motors and mechanical apparatus beyond reasonable service requirements, or to trust important lines to effete circuit breakers and old-fashioned relay protection on the principle of "taking a chance" in the hope of saving investment outlays. Now and then one hears of exceptions to well-managed properties where such transgressions of true economy are viewed with tolerance, but we believe the condition is not generally prevalent. Today strong and courageous policies are needed—policies which embody executive support and engineering cooperation for the lasting good of both investor and customer.

Multiple sales plans gain acceptance

UNDER the spur of action by some utilities and department stores a few electrical appliance manufacturers are developing new sales plans based upon selling a combination or group of appliances to the households under a one-sale installment-payment plan. Last week the Westinghouse Electric & Manufacturing Company announced a dealer plan of this kind with definite provisions for contracts, installment paper and group appliance sales.

What multiple selling can mean is made evident by consideration of a "full-use" electric home. An actual example of sales of individual appliances to a purchaser using 10,000 kw.-hr. per year shows that by individual sales methods the customer paid $1,225 for his appliances, the wholesale price of which was $695. Yet even with this mark-up participating sales agencies made little if any profit. Based upon the multiple-selling principle and one sale, this householder, on a 40 per cent mark-up of appliances, could have purchased his group electrical equipment for $973. The most expensive merchandising mechanism in use is the specialty salesman or distributor set-up for selling single appliances. Yet many manufacturers in the industry still believe this method must be employed, and some are going to the extreme in its use at this time. We doubt its necessity and question it seriously as a distribution method except for a pioneer appliance in an introductory period.

Current reports on merchandising from utili-

ties using the group appliance sales plan are very favorable; in fact, several assert that under existing conditions this method is the only one that permits them to sell appliances in volume. Economy in distribution means a minimum of sales agencies in the marketing chain, a minimum number of sales contacts with customers and the sale of multiple products at one sale. Any deviation from a distribution economy program, granted equal sales value, is a step backward in developing the domestic market.

Simplification in house-wiring practices means economy

REGARDLESS of the merits or demerits of the controversy of many years between the proponents of all-metal and those of other wiring systems, there appears to be one basic advantage to the public which is realizable upon the adoption of a rational and specific standard. Wherever any national simplification plan has had a test over a considerable period of time, the resulting economies through the elimination of many varieties and types of products or systems have given to the public higher standards at a lower cost and to the manufacturers a greater volume of sales and a more stable market. Concentration on a product or system means over-all economy.

Progress, however, will not and cannot be stifled, pleasant or unpleasant though its toll may be. No art, practice or condition can remain static indefinitely. Any standards which are established must admit of variation as the factor of mutability asserts its dominance. In the interim accepted standards do definitely aid in rationalizing procedures and in providing economies.

The electrical industry should study thoroughly and fairly the all-metal standard advocated by the Association of Electragists International to find out its merits as a simplification program that may lead the way to better and more adequate permanent wiring of homes. Any efforts to force the proposal upon the public or the industry, however, through municipal ordinances or underwriters' outlawing of other types of wiring would be disastrous, because the way to an end is agreement, not force, and because it cannot be proved to any reasonable satisfaction that the all-metal or any other standard is the only acceptable or "right" way to do things. The merits or demerits of the plan should be determined by a fair and open-minded investigation of its over-all economic advantage as a national simplification plan that will expedite the development of the wiring market.

Welding loads jump to five figures

FAR-SIGHTED as it has been, the power industry has seldom faced loads that it was not prepared to supply. Missionary work in new fields has usually been anticipated by provision of system capacity to meet whatever business was won. This has been true in general even of electric welding, but so fast is the acceptance of that process taking place that the reverse may at any time be true. Flash welding of pipe seams at the rate of 35 to 40 feet per minute requires an input of about 1,200 kilowatts. In a still more profligate use of power to attain process speed whole 36-foot lengths of two-foot pipe, one-half inch thick, are being welded at one time by a battery of ten or twelve welding machines operating in parallel. The job is done in one minute, and the power required totals 11,000 kva.

Compiling the 1931 developments, the meetings and papers committee of the American Welding Society includes these instances and concludes that "the only limit to the size and power of electric welders is the amount of power that the power companies will be able to furnish to customers for welding purposes."

This constitutes a challenge. The power companies have never sidestepped such an issue. Those who can see this one coming their way will do well to forsake the alibi defense, plead guilty if they are caught unprepared and undertake to conform. It will be a big system that can meet such loads concentrated at one point. There are two "ifs." One pertains to the jolt experienced by the generating units and transformation units on the system, and the other to the jolt pretty sure to be given to service of neighboring customers. The "ifs" will fade as fast as measures for meeting abrupt changes in load and voltage are extended downward from the realm of the interconnected system into the province of the localized situation. It is another case where the once cute little tot has suddenly been recognized as a strapping youngster.

William Elliott Wood

WITH South Carolina as a birthplace, North Carolina and Georgia as the states where he received his scholastic education, and Florida, Texas and Virginia as the scenes of his earlier business activity, William E. Wood, vice-president in charge of operations of the Engineers' Public Service Company, is one of a number of utility executives with headquarters in New York City who owe their success to the record gained in public service below the Mason and Dixon line. His birthplace was Aiken, his almæ matres were Davidson College and the Georgia School of Technology, whence he was graduated with an electrical engineering degree in 1907 at the age of 20, and the scenes of his operating-company connections were Jacksonville, Houston, El Paso, Galveston and Richmond.

All these companies were controlled by Stone & Webster, with which firm Mr. Wood became associated just after his graduation, going first to Boston and then, in 1908, to the Jacksonville Traction Company. In five years he worked up through the ranks of the railway company to the post of superintendent. Three years later, in 1916, he was transferred to Texas to be superintendent of transportation of the Houston Electric Company, and in 1917 he was made superintendent of railway of the El Paso Electric Company. A year later he became manager of the Galveston Electric Company, and in 1920 he went back to the Houston Electric Company as manager of that utility,.

In 1925 Mr. Wood was made operating vice-president of the Virginia Electric & Power Company at the time it was purchased by the Engineers' Public Service Company. In 1927 he became president of the Virginian company, and in November, 1929, in recognition of his ability and outstanding work in the development of this property, he was appointed vice-president of the Engineers' Public Service Company. Mr. Wood is also a director of the Engineers' company and many of its constituent companies, including the Virginia Electric & Power and the Puget Sound Power & Light. He has been active in the affairs of the National Electric Light Association and the American Electric Railway Association. He served as president of the Southwestern Public Service Association just before removing to Virginia.

New Hydraulic Design at Tiger Creek

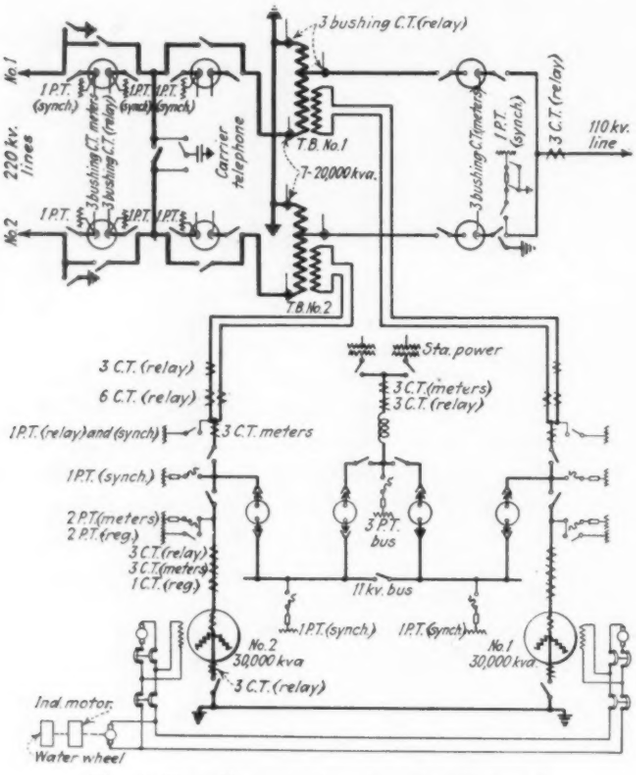
By F. I. LAWSON
Assistant Engineer
Pacific Gas & Electric Company, San Francisco

Minimizing water disturbance produces high efficiency on 36,000-hp. impulse waterwheels.
Method of load rejection and governing are features.
Electrical layout is simple.

RECENTLY completed efficiency tests on two 36,000-hp. double-overhung impulse waterwheels at the Tiger Creek plant of the Pacific Gas & Electric Company showed results that have created interest in certain new features of hydraulic design. These include a number of refinements for increased efficiency and safety of operation and novel features of construction, some of which are utilized for the first time with units of large size. These embrace rolled steel wheel disks, triple cooled rigid bearings, all-steel housings, hydraulic brakes, dual control governors, etc.

Straight flow needle nozzles of an improved design which bring the water to the jet with a minimum of disturbance are used. The nozzle is stationary, being partially imbedded in concrete, and in order to take the water quickly away from the wheel after sudden loss of load a jet deflector is used, consisting of a heavy collar or annular ring which deflects the jet clear of the buckets. Some of these features may be seen from one of the accompanying illustrations.

The control of the jet and its deflector during normal as well as abnormal conditions is quite interesting and represents an entirely new development by the Pelton Water Wheel Company. Oil pressure, from a pressure supply system which is automatically maintained by either an electric or a water motor, is applied through a flyball-controlled pilot valve to both the needle and the deflector cylinders simultaneously. Small changes in speed cause proportional applications of pressure which affect only the needle cylinder. Large pressure changes, such as may be caused during load rejection, build up pressure in the cylinders faster than it is permitted to be relieved by needle movement and this brings the deflector into play. During such conditions the water can be completely removed from the wheels in three seconds. Closure of the needle for water-saving purposes and the return of the deflector to its normal position follows at a much slower rate, thus reducing water hammer in the penstock.



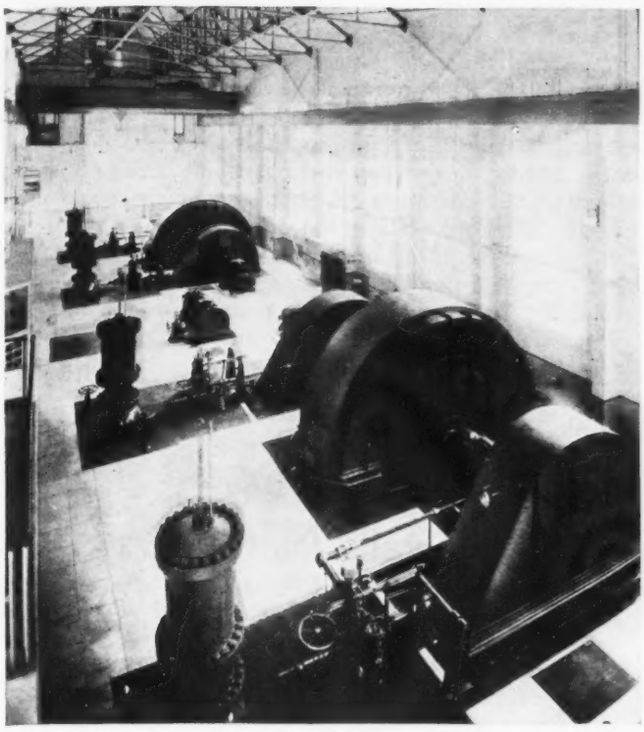
Single-line diagram showing simplicity of electrical layout

Pressure surges avoided

The rates at which the needle may travel in the opening and the closing directions and at different parts of its strokes are fixed by locked adjustments entirely separate from the controls manipulated by the operator, so that no possible mishandling can produce sudden movements that would result in pressure surges in the penstock. Pressure charts over a period of extended operation have shown that pressure changes during starting and synchronizing are barely detectable, while the pressure surge accompanying instantaneous rejection of full load is little more than the static pressure.

Each needle is controlled by an independent governor-deflector device and the entire operation is exceptionally positive and well adapted to the conditions encountered, following as it does so closely the operation of relief valves used with reaction turbines as to over-all effect, but with a far smoother action as there is no transfer of the flow from the working to the by-pass orifice, with the inevitable resulting fluctuations.

A feature that proved of real value during the initial stages of operation, when it was necessary to pass a constant flow through the plant regardless of load, is the readiness with which control of the needle position can be transferred from the automatic speed governor to an entirely independent hand mechanism. Thus, by the



Interior of Tiger Creek power house

throwing of a single lever, the control can be instantly converted from water regulation by the governor to hand regulation of the water flow, with the governor operating the deflector only for speed control, and this without change of speed or alteration of the governor setting. The construction admits, should water conditions warrant, of applying an electric water-level control to the needle, so that the plant at all times would pass exactly the amount of water entering the forebay, with independent deflector control of the speed and load.

Control of the governors is brought to the switchboard in very complete fashion. Independent motors are provided for the speed control and load limit of each governor, and "selsyn" transmitters show the positions of the needle and the load limit on a single switchboard-receiving instrument having two concentric hands, geared to the same angular travel, to give the operator a graphic conception of the relative settings. The governors are gear and shaft driven from the main shafts and electric tachometers are used exclusively, with indicators both at the governors and switchboard.

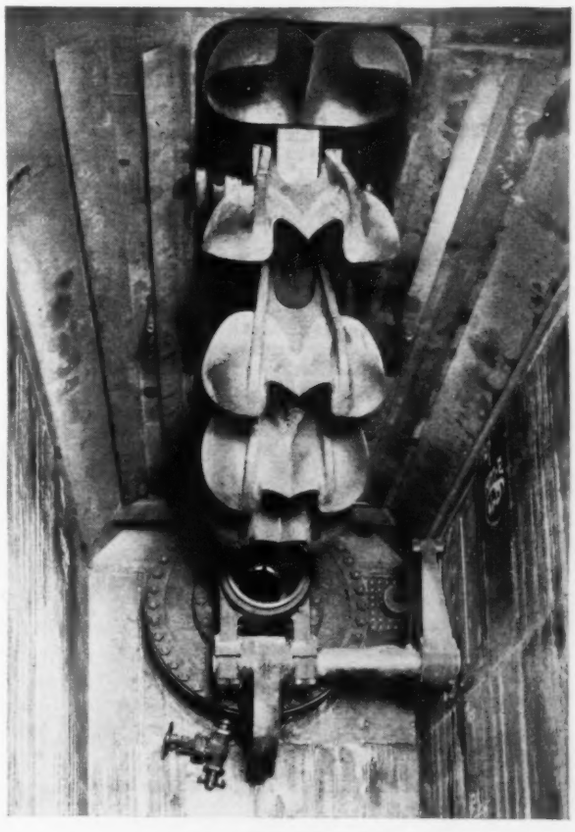
The operator also has complete remote control of the water entering the forebay from the regulating reservoir, several miles above the plant, and the water leaving the afterbay at its outlet, a mile down stream.

The programmed development of the Mokelumne River, on which the Tiger Creek plant is located, allotted a flow for the plant of 550 sec.-ft. under approximately 1,200-ft. head, permitting a plant capacity of 60,000 kva. Topographic conditions gave only 42 acre-ft. forebay capacity, which would permit of very little, if any, peak capacity. This has been somewhat augmented by a regulating reservoir some 2½ miles farther upstream from the plant. The entire plant output is but a unit in a system which includes 50 hydro-electric plan[illegible] having a total capacity of 400,000 to 600,000 kw. The design of the plant thus resolved itself into practically a block-load plant with full freedom in the choice of number and size of units.

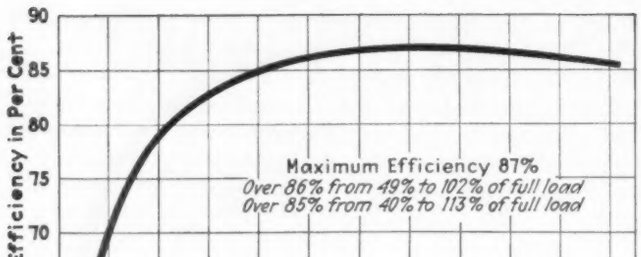
These factors, together with a rather complete utilization of automatic and remote-control features, permitted a number of economies to be made in the plant layout and its operation, notably the reduction in low-tension switching facilities and the use of but a single penstock.

The major items of equipment in the plant include two 30,000-kva., 11,000-volt generators driven by double-overhung impulse wheels developing 36,000 hp. at 1,190-ft. net head. Charging current requirements for the Tiger Creek-Newark 220-kw. transmission lines amount to 24,000 kva. per circuit, and this was an important factor leading to the choice of two units. Each generator is normally operated with an associated step-up bank as an integral unit. In addition to taking the generator output, each bank is also capable of simultaneously stepping the full 30,000-kva. ultimate output of the Salt Springs plant, further up-stream, up to the 220-kv. transmission voltage used from Tiger Creek to Newark. This additional power, which arrives at 110 kv. from the smaller plant, goes through an auto-tap on the high-voltage winding of the bank, thus giving each bank a rating of 30,000 kva. input at 11 kv., 30,000 kva. input at 110 kv. and 60,000 kva. output at 220 kv.

The simplicity of the electrical layout is evident from the single-line diagram of the station, from which it will be noted there are no oil circuit breakers between the generators and transformers. The 11-kv. switching facil-



New type water deflector and load-rejection mechanism in wheel pit of impulse wheel


Efficiency in Per Cent
90
85
80
75
70
65
Maximum Efficiency 87%
Over 86% from 49% to 102% of full load
Over 85% from 40% to 113% of full load
0 10 20 30 40 50 60 70 80 90 100 110
Output in Per Cent of Full Load

Improvements in hydraulic design produced a maximum efficiency of 87 per cent

ities shown are used primarily for synchronizing before paralleling on the 220-kv. or 110-kv. breakers and for providing power for station purposes. The 11-kv. switching is arranged in a steel cell structure with removable truck-type breakers.

Operating flexibility is provided in the equipment and its arrangement as installed in the high-tension outdoor switch structure. Four 220-kv. oil circuit breakers of two different makes are installed for the transformers and the lines to permit of maximum continuity of service without sacrificing relay protection for either the lines or the banks. This is accomplished by interlocked transfer facilities, which enable the transfer of line protection to the adjacent transformer breaker during servicing of the line breaker, and conversely the transfer of bank protection to the adjacent line breaker during outages of the transformer breaker. A remote-controlled motor-operated air switch is also included to tie the two high-tension sections together.

The line relay protection for the 110-kv. as well as the two 220-kv. lines includes directional residual relays for line-to-ground faults and directional overcurrent relays for phase-to-phase faults and for back-up protection. Generator-type (low percentage) differential relays are used for the 11-kv. delta windings of the transformers and three-coil percentage differential relays are applied to the three terminals of the high-voltage winding. The banks are further protected by overvoltage relays, made necessary by the excess voltages occurring on the 220-kv. lines when energized only from a distant source. The generators are protected by the usual percentage differential relays; no overload relays are used. The elimination of oil breakers between each generator and its transformer, of course, necessitates the isolation of both when the relays on either are tripped.

Electrical as well as hydraulic operation of the entire plant is centralized in the control room, which has resulted in a high degree of operating convenience as well as economy.

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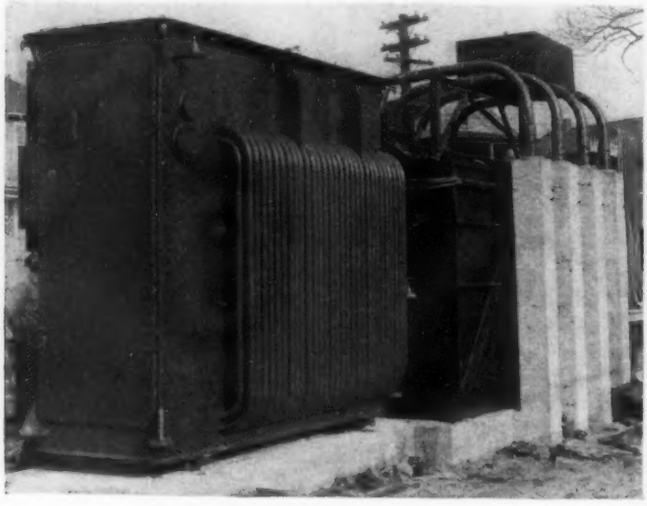
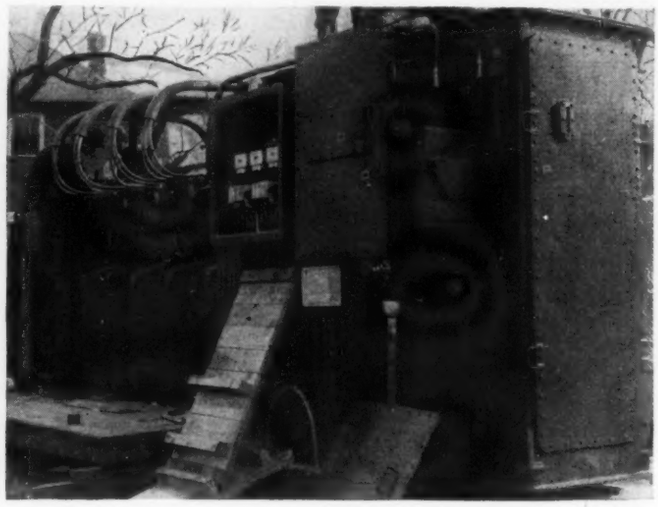
Malden Installs Network Unit Outdoors

Part of the Christmas peak load of the Malden (Mass.) Electric Company in the Medford district was served by a newly completed 1,500-kva. General Electric 4-kv., metal-clad network transformer and switching unit of the vault type installed outdoors on a concrete mat and fed by a 22-kv. underground cable tied into the transmission system of the Eastern Massachusetts Electric Company. It was found less costly to erect the unit outdoors on a lot purchased for the purpose than to build an underground vault for this nucleus of a future 4-kv. network system. Four three-phase, four-wire grounded neutral feeders leave the unit in rigid conduit supported over the metal-clad switchgear and bus compartments and pass underground through concrete protecting piers as shown, the conduit being carried on a $2\frac{1}{2}$-in. angle frame. Automatic reclosing breakers are provided for the outgoing feeders, with an automatic non-reclosing breaker in the 4-kv. taps from the transformer secondary. Automatic load ratio control equipment is installed integrally with the transformer compartment with metal partition between, instead of separately housed. This is believed to be a pioneer outdoor installation of vault type 4-kv. network units.

Transformer and automatic load ratio control in network unit housing

Metal-clad switchgear and feeder take-offs shown at right in the left-hand view, with 24-volt trip battery box on top of unit. Right, front of network unit for 4-kv. service under construction.





Stretching the Purchasing Dollar

By EDWARD T. GUSHEE

Purchasing Agent Detroit Edison Company, Detroit, Mich.

Savings as high as 85 per cent annually on specific items have been made in the Detroit Edison Company by employees who analyzed their jobs and the costs of doing them.

Purchasing department is merely the agent of economy, not its originator.

FOR every dollar received in revenue by electric utilities an increasing number of dollars is being spent in plant and equipment. More capital is required to produce one dollar of gross earnings by electric utilities than by any other leading American industry. For a number of reasons that are known to all well-informed utility men it is impossible to stop this tendency entirely. This article is not concerned with those reasons. It is concerned with common-sense ways in which the tendency can be checked, its acceleration reduced.

The task of the engineer—classically defined as a man who with one dollar can do what any fool can do with two dollars—is far easier today than it was in the late-lamented era of high prices. But is the engineer solely responsible for the efforts to keep down both investment and operating expense?

Indeed not? Then who is? The president? The general manager? Oh, surely the chief engineer—or perhaps the purchasing agent?

Responsible, yes—but not nearly as effective in economy as thousands of the regular personnel of every department of the company. Who is it who requires the replacement of materials to do his job? It is the man on the job. What of the materials? They make a strange diversity of "creatures"—poles and pencils, soap and soda, tea and transformers, lamps and locomotives, glass and gaskets, chisels and circuit breakers, typewriters, iodine, wire, oil, water, tires, tubes, and so on, through a list that in the Detroit Edison Company runs up to 65,000 items and with a value in the company's purchases that has ranged from seven to twenty-seven millions of dollars annually.

Now these—by recent deductions—are new times. Never was the ingenuity of suppliers so exercised to provide a more economical means for doing a given job. Never were there so many new things and new prices. We hear of glass wool as insulation, of an entirely new process of printing, of electricity saving the use of running water. The phrase "ultimate value" may be defined as "the quality best suited for the job at the lowest ultimate price." Today the opportunity definitely presents itself as never before to the operating personnel of electric utilities to save money in the purchase of equipment and materials used in their individual jobs.

Such savings do not necessarily imply a smaller use of material or any reduction in grade or quality. One of the most effective but at the same time most difficult ways of saving money is by the re-examination of old practices so ingrained in our routine habits as to be imperceptible to us. This re-examination does not always result in saving money, but that is not the only way in which it can be done. The random list of items and savings that accompanies this article shows different methods of economy that range from the securing of an actually better product at a lower price, through stock reductions and anticipation of requirements, to the substitution of a chemical formula for a trade name. This list is not by any means complete. It is merely illustrative of what has been done by the Detroit Edison Company and of the methods by which the economy result is being achieved.

I want to emphasize that the savings, economies and improvements cited in this article are not to be credited to the purchasing department of the Detroit Edison Company. In every case they are the result of co-operative effort. The examples come to the attention of the purchasing department because of its records. No com-

Typical Purchasing Savings of the Detroit Edison Company

Item	Economy Method	*Estimated Yearly Saving, Per Cent
Window guards	Design	51
Trolley cord	Non-trade marked product	30
Sponges	Specification	27
Brick	Specification	19
Turpentine	Specification	25
Catalogue	New process of reproducing	80
Record files	Different equipment	85
Stoker castings	Stock reductions	22
Insulating tape	Non-trade marked product	67
Insulating brick	Specification	30
Tool bags	Design	18
Paper towels	Quantity purchase and specifications	33
Wood partitions and trim	Different vendor	46
Protector gloves	Design	11
Cement bags	Different bag	7
Ground wire molding	Specifications and bulk purchase	26
Oil for air filter	Non-trade marked product	50
Varnish remover	Specification	53
Steel plates	Specification and bulk purchase	32
Rural service extension	Specifications and adaptation of salvaged material	15
Cleaning compounds	Analysis and specification	25
Engravings	Different vendor	30
Printed forms	Anticipating requirements	22
Index cards	Vendor and specification	65
Fire extinguisher liquid	Specification	50
Medical pill	Non-trade marked product	70
Oil	Reduced quantity at same unit price	10

* The bulk amount of these savings ranges from $100 to $32,000 per purchase.

mittee on standardization has to be appointed in order to save money. Every one who is responsible for requisitioning has the opportunity, the responsibility, the possibility for credit by re-examination of current needs. We all know why money must be conserved. The important thing to be realized is that everything each of us uses in the daily job costs money, and that because of these new times the probabilities are at least even that a new study of our daily requirements would result in the saving of money. The chances of saving money on large purchases have been greatly reduced. The really fertile field for economy is in the regular requirements of small items.

Again I say, these are new times and it behooves every one—from the watchman to the plant engineer, from the office boy to the department head, from the helper to the group foreman—to ask himself whether or not he knows definitely that no better ultimate value can be obtained in the products he uses; that no product which he heretofore has ordered can be eliminated; that no new invention, development or substitute will do better, or as well, the work which he has formerly done with an established device—all, of course, without endangering, weakening or sacrificing the total economy of the system.

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7 to 8 Per Cent a Ruling Rate of Return

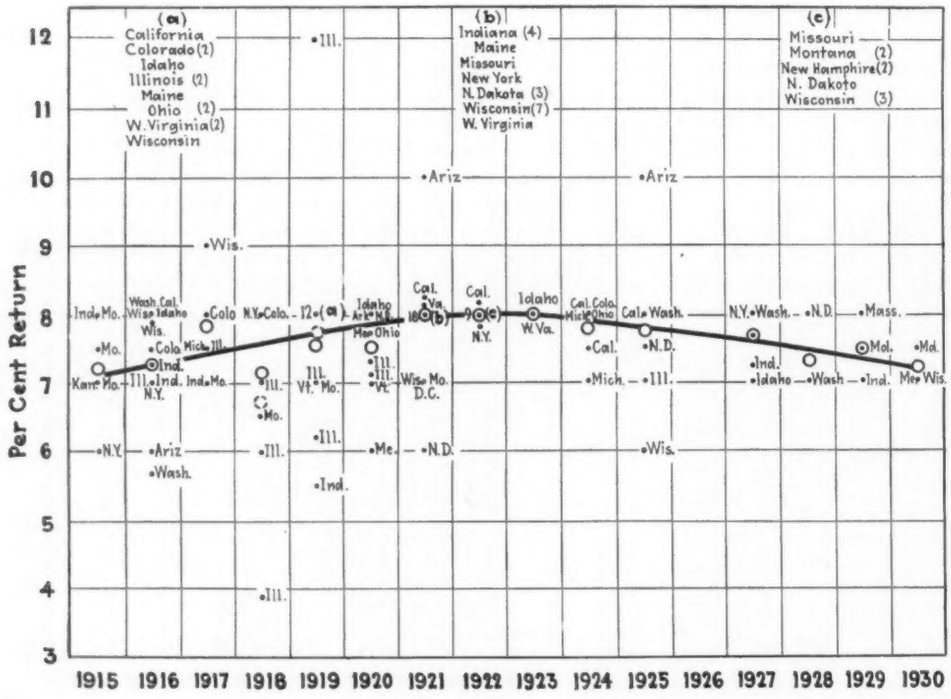
Between 1915 and the end of 1930 there were 120 cases of commission decisions reported in Public Utilities Reports in which a rate of return for electric utilities was fixed. These ranged from a minimum of 3.85 to 12 per cent, with the great majority of the cases lying between 7 and 8 per cent. A plot of these rates of return shows a definite trend from 7 per cent in 1915 to 8 per cent in 1922 and a decline again toward 7 per cent in 1930. The average (unweighted for the fair values with which the rates of return are associated, because the fair value is not always specifically stated) is in each year indicated by a circle. The two extreme values were ignored in ascertaining the averages for 1918 and 1919 because these cases appeared to involve unusual circumstances; they tend anyway to compensate one another in the trend. The number of cases in the last four years is too small to give any true index of any tendency of the rate to rise or fall in conjunction with the present disorganization of the investment field.

Various expressions were used by the commissions in promulgating the orders on which these data are based. What has here been called simply the fair return was variously referred to as "adequate," "allowed," "ordered," "rates fixed," "rates established," "reasonable," "authorized," "not excessive," "held sufficient," "not confiscatory," "sound," "rates to yield."

It is fairly evident that the rate of return allowed rose during the war period, when competition with war industry for capital made a rising rate necessary to keep an essential industry supplied with adequate funds for plant expansion. This same period was an era of rate increases temporarily made to meet rising operating costs. It was also the period of rate litigation and engineering valuation on an extensive scale.

Soon afterward the industry had captured the imagination of the public as an investment medium, its credit standing rose, money became easier to get, rate of allowed return fell, rates for service dropped and litigation diminished in consequence. Evidently rate of return in the last decade and a half has been influenced primarily by money cost and not materially by construction costs or the fluctuating purchasing power of the dollar.

These 120 cases came from 21 of the 41 states which in 1930 had jurisdiction over the rates of electric utilities. Geographically, however, the regulatory sentiment



Allowed return for electric utilities had high in 1923

There were too many 8 per cent decisions in 1919, 1921 and 1922 to record them against the points, therefore they are listed in the tabulation below for those years:

Arizona	3
Arkansas	1
California	7
Colorado	6
Dist. of Col.	1
Idaho	5
Illinois	13
Indiana	11
Kansas	1
Maine	4
Maryland	2
Massachusetts	1
Michigan	3
Missouri	10
Montana	2
New York	6
N. Hampshire	2
N. Dakota	9
Ohio	4
Virginia	1
Vermont	2
W. Virginia	4
Washington	5
Wisconsin	17

of the whole country is well represented, except perhaps for the Southern states. Wisconsin, pioneer in regulation, was the most active, with seventeen decisions here tabulated; Illinois, Indiana and Missouri follow with thirteen, eleven and ten respectively.

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Western Industrial Decline More Gradual than Eastern

In the far West industrial activity has gone through a somewhat different series of changes than in other parts of the country. As elsewhere, it was high in 1929 and has since slackened, but there the similarity ends, for the several geographical regions differ as to their leading industries and hence their response to the ebb and flow of the latter. Thus the condition of the automobile industry affects the Central States much more than the West.

The table and chart here given for the West correspond to those previously published for other regions: New England in the issue of September 5, 1931; the Middle Atlantic, September 19; the Middle West, October 10; the South, November 7. Current figures appear monthly.

These indices, referred in each case to the average of 1923-25, are compiled from reports of electrical energy used in representative manufacturing establishments, analyzed by industry groups and suitably weighted to give national and regional averages.

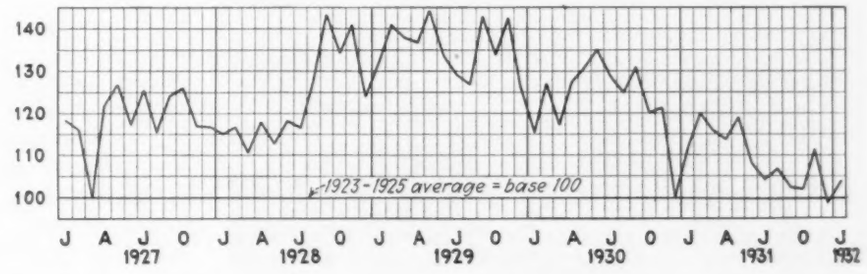
In the present group, the West, the decline during 1930 and 1931 will be seen to have been much more gradual than, for example, in the two Eastern groups and much less severe than in the North Central. The continued high level of food industries contrasts sharply with the great decline in the metals group, consisting in large part of metal-working plants. Consumption of foodstuffs continues; installation of new machinery lags, in the West as elsewhere.

In view of their derivation, these index numbers cannot take account of variations in price and do not measure sales, but they do reveal with considerable faithfulness the variation in the rates of factory operations.

Indices of Industrial Activity in the West

Adjusted for 26 Working Days

	1927				
	Jan.	Feb.	March	April	May
All industry	118.7	116.1	100.1	122.1	126.8
Chemicals	127.4	115.4	85.8	117.7	118.4
Food	95.3	98.5	83.8	111.4	113.2
Metals group	135.4	144.3	130.7	154.0	161.0
Lumber	114.8	110.0	91.1	107.4	115.8
Paper and pulp	139.5	130.3	118.7	131.0	137.6
Rubber	.....	.....	.....	123.5	123.3
Shipbuliding	129.3	120.4	117.7	124.4	134.0
Stone, clay and glass	.....	.....	.....	137.0	150.5



	1927							1928											
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
All industry	117.2	125.4	115.3	124.6	125.7	117.0	116.9	115.0	116.7	110.4	117.8	112.9	118.5	116.5	127.5	143.4	134.8	140.7	124.0
Chemicals	106.5	110.8	96.8	98.6	89.8	89.4	84.7	102.8	106.9	104.6	108.7	90.0	88.2	92.3	84.4	94.6	92.8	97.3	99.7
Food	111.3	133.5	134.5	144.0	164.2	140.0	148.5	113.8	104.8	101.8	103.0	97.4	110.4	108.4	125.1	152.3	148.0	152.2	115.9
Metals group	136.8	144.2	99.6	111.2	104.3	97.8	108.8	133.8	123.0	113.3	123.3	124.0	122.2	123.4	118.0	152.6	148.7	156.8	144.0
Lumber	109.4	112.8	115.2	120.0	121.5	120.0	110.7	119.2	124.2	122.0	127.6	128.2	132.2	135.8	158.7	163.0	144.5	151.0	143.8
Paper and pulp	130.7	127.5	127.2	135.2	147.4	142.6	132.4	136.2	139.7	131.2	150.3	150.0	144.5	147.5	151.7	155.7	156.8	162.4	141.0
Rubber	121.5	116.6	111.0	117.8	119.0	107.7	113.7	140.2	159.8	153.6	140.8	133.7	136.8	160.0	173.2	160.5	183.5	164.2	142.8
Shipbuilding	123.4	109.8	106.2	101.2	110.7	102.1	95.8	96.3	100.5	84.7	104.6	94.2	95.7	75.6	75.6	81.2	83.0	96.2	85.3
Stone, clay and glass	144.8	150.0	142.3	151.6	138.3	159.0	142.0	150.4	170.8	139.4	155.2	154.5	153.0	111.5	129.8	130.7	124.8	133.6	128.5

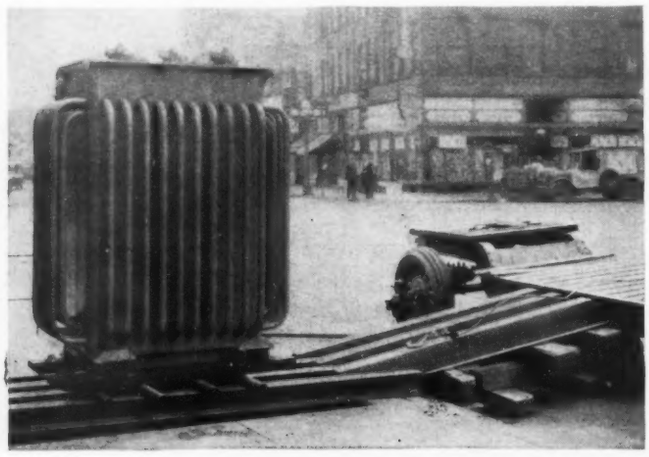
	1929												1930					
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June
All industry	131.9	140.8	138.2	137.0	144.7	134.2	129.4	127.0	143.1	133.8	142.6	126.0	115.2	127.5	117.4	127.6	130.5	135.0
Chemicals	93.9	100.2	95.6	97.6	103.1	91.2	104.4	95.7	99.3	109.0	109.7	106.0	107.4	109.8	108.8	103.7	102.9	109.7
Food	138.4	149.3	142.6	140.0	125.4	121.5	118.8	124.5	153.0	141.5	131.3	138.8	124.7	126.5	110.6	136.3	141.4	147.5
Metals group	141.6	167.6	206.8	153.2	160.0	134.1	135.0	123.8	151.4	120.2	141.7	121.0	94.5	116.4	109.5	92.5	99.5	108.5
Lumber	138.3	153.0	147.2	150.4	183.3	161.0	148.0	151.0	153.6	152.2	184.6	132.3	126.0	155.3	135.7	167.8	169.2	164.5
Paper and pulp	151.8	152.3	135.4	129.0	146.7	142.0	134.0	139.0	146.4	147.2	144.8	150.3	137.3	130.6	140.0	123.0	132.2	138.5
Rubber	192.3	209.0	200.7	198.1	196.3	197.0	179.7	154.0	147.7	154.8	137.0	100.0	174.0	164.0	160.8	168.2	180.0	168.0
Shipbuilding	121.7	94.2	94.1	109.2	127.0	99.7	95.0	106.4	91.3	92.8	107.1	113.4	117.0	117.5	110.7	122.2	106.3	109.3
Stone, clay and glass	140.4	129.2	131.3	145.3	130.8	167.0	149.2	123.5	157.0	138.8	121.0	102.9	106.4	95.2	99.4	91.5	94.9	113.8

	1930						1931											
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
All industry	129.0	125.0	130.9	120.0	121.3	99.9	111.0	120.0	115.7	114.0	119.1	108.0	104.4	106.5	102.3	102.2	110.9	98.3
Chemicals	97.3	96.7	86.0	84.2	97.0	80.7	82.4	85.7	71.8	75 2	90.2	78.0	87.8	77.1	78.1	88.0	98.9	88.3
Food	139.2	135.0	156.5	148.1	141.0	88.9	126.0	149.3	148.4	138.1	144.8	135.4	135.5	155.7	134.5	131.8	149.0	134.4
Metals group	96.8	91.1	90.3	92.3	76.7	71.1	71.6	74.4	64.1	71.4	69.7	60.8	47.3	43.8	43.4	45.2	46.9	32.7
Lumber	167.8	168.2	168.0	164.0	151.3	145.7	136.9	146.0	152.1	150.1	154.1	139.0	126.0	129.1	129.0	128.1	135.5	124.8
Paper and pulp	130.7	129.2	122.7	137.2	128.8	116.0	126.0	128.3	125.3	120.6	143.3	132.4	124.2	115.5	126.3	114.3	122.2	110.6
Rubber	154.0	140.5	127.0	151.5	119.4	105.5	157.0	173.0	155.0	155.6	166.0	151.9	146.0	103.1	115.1	107.4	68.1	53.7
Shipbuilding	109.8	115.1	116.8	113.0	108.5	89.0	112.9	106.6	88.7	82.0	74.5	80.5	77.8	85.2	96.2	88.1	98.1	87.8
Stone, clay and glass	104.9	103.3	113.1	115.3	123.5	102.5	93.8	106.0	94.9	94.6	80.2	85 8	115.5	99.5	93.9	87.3	112.3	79.0

Transformer Lowering Device Aids Vault Installation

By D. M. BUNN
Superintendent of Distribution
Northern States Power Company, Minneapolis, Minn.

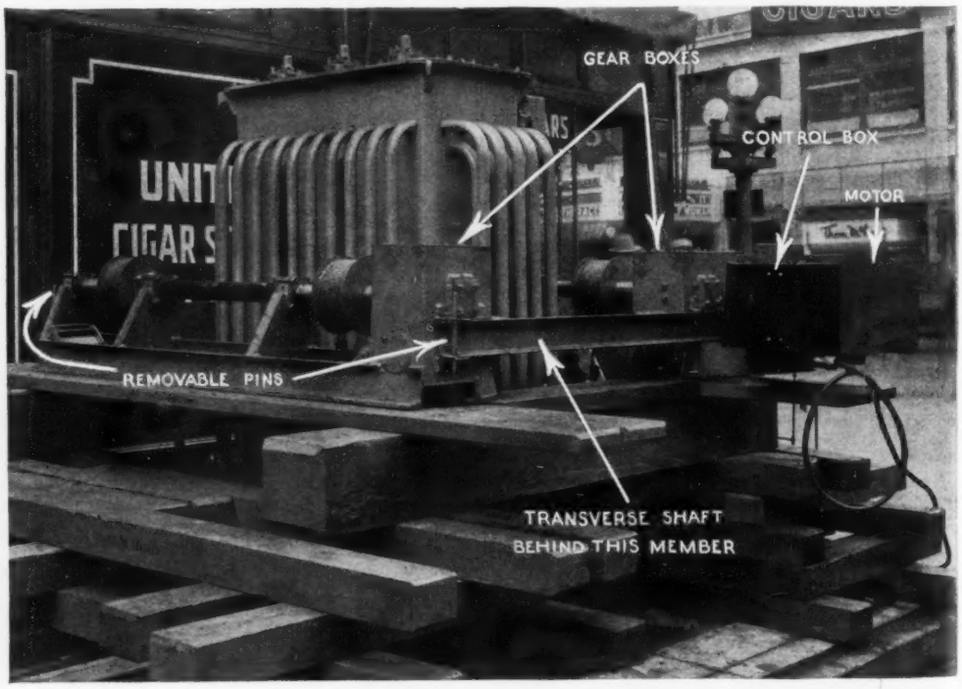
The decision of the Northern States Power Company to use three-phase transformers in the vaults of the alternating-current low-voltage network system in Minneapolis created the problem of lowering and raising these transformers into and out of the vaults. Several schemes were considered other than the one chosen, including a truck-mounted crane and a portable rigging with an overhead chain block of some sort. The device finally decided upon is shown in the accompanying illustrations and resembles a casket-lowering machine in its operation. The principal advantages of this device are that it required a comparatively small investment and there is no overhead structure likely to topple over in erecting, dismantling or in operation. Furthermore, it can be operated by a motor.



The device has two parallel shafts, each having two drums carrying about 30 ft. of $\frac{1}{2}$-in. plow steel cable equipped with turnbuckles and hooks for attaching to the jacking lugs of the transformer. Each main shaft is carried on roller bearings and is driven by a worm and gear. The two gear boxes are connected with each other by a transverse shaft containing universal joints so exact alignment is unnecessary. A single motor on one shaft drives both drum shafts. The two drum-shaft units are tied together with channels, which can be removed by taking out four pins. The transverse shaft connecting the two units is removable and adjustable. The worm and gear driven by the motor as well as the worms driving the gears on the main shaft are carried on Timken bearings. Power to operate this device is supplied by a 3-hp., 110-volt, single-phase, 1,200-r.p.m. reversible repulsion-induction motor controlled by magnetic contactors and operated by push buttons. Incidentally, it can be operated by hand if electric-service circuits are not accessible.

Bases, bearing supports, etc., are fabricated from structural shapes by electric welding and, to facilitate handling, the units are equipped with rollers. All gears are inclosed in oil-tight welded steel cases filled with regular transmission oil, while other bearings are fitted with nipples for lubricating with a grease gun.

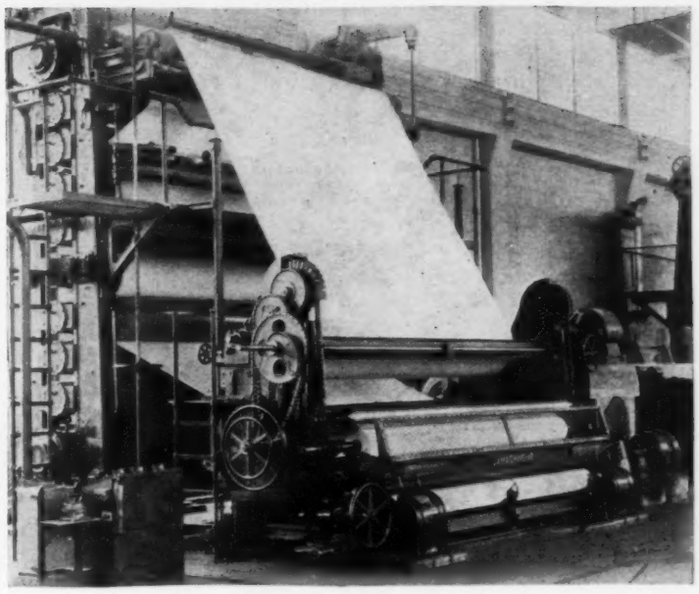
The drums are keyed onto the main shafts so that they may be moved to accommodate variations in setup and the distance between the main shafts can also be varied to suit conditions. The machine was conservatively designed for a capacity of 6 tons and gives a lifting speed of 20 in. per minute. The nature of the reduction gearing gives a non-reversing effect and the load comes to a stop almost instantly after the power is shut off.



Two stages in placing vault transformers

The transformer is rolled to the proper position over the opening on four "H" beams. The timbers are then placed in position and the parts of the machine rolled off the truck onto the timbers, where it is assembled and the motor connected to the power supply in the vault. After the cables are attached to the lugs at the bottom of the transformers the "Up" button is pushed, raising the transformer enough to remove the "H" beams. The "Down" button is then pushed until the transformer reaches the floor of the vault. The total time required to lower or raise a transformer, including the time from the departure at the storeroom and return, is two to four hours, depending on the distance from the storeroom and conditions at the vault, and requires the services of about eight men, one truck and one trailer.

Synchronized super-calender and winder eliminates intermediate operation



By C. W. DRAKE*
Westinginghouse Electric & Manufacturing Company
East Pittsburgh

Paper Production Aided by Synchronized Super-Calenders

THE economic necessity during the last few years of producing super-calendered papers at a still lower cost is largely responsible for the introduction of machine-width super stacks operating at high speeds and finally the use of synchronized winders so that shipping rolls may be produced directly from the machine-wound rolls. Thus the extra handling and labor of rewinding, slitting and trimming are eliminated and with an economically arranged mill material savings should be effected. Although these large high-speed stacks might have been constructed with the conventional bearings, it is felt, nevertheless, that much of the success of the new machines is undoubtedly due to the use of ball or roller bearings throughout. The use of such bearings not only makes a material saving in the power consumed and size of electrical equipment required but the reduced starting friction and uniformity of same is of great assistance in the proper design and operation of electrical control equipment.

A recent installation in the mill of the Bryant Paper Company, Kalamazoo, Mich., of two 160-in., ten-roll, double-finish super-calender with two-drum winders includes a number of new and interesting operating features. The calenders were supplied by the Textile-Finishing Machinery Company and are equipped with anti-friction bearings throughout, i.e., on top and bottom rolls as well as thrust bearings on all the intermediate rolls, five of which are cotton and the others steel. The winders are of Cameron make, type 48, model 9, with 160-in. drum face and equipped to wind rolls up to 36 in. diameter and at a maximum speed of 900 ft. per minute.

One complete unit consists essentially of an unwinding reel, a calender and a winder, but all are electrically equipped and so connected that they operate as one synchronized machine. The schematic layout shows the main driving equipment and the principal interconnections. The main calender drive is a 250-hp. wound-rotor induction motor operating on dual-frequency control, one frequency changer supplying low frequency for both calenders. The direct-current generator on the reel feeds its power back to the calender through another direct-current machine, the regulating equipment maintaining the current or tension as desired.

Of principal interest, however, is the winder drive, which utilizes wound-rotor induction motors so connected as to give a synchronous speed relation between the calender and the winder. With a drive of this type there is a definite speed relation between the calender and winder regardless of whether paper is being wound or not. On the new drives at Bryant a very light roll suspended by springs is placed between the calender and winder to introduce a flexible element in the draw, but it in no way affects the speed or regulation of the winder. Due to the fact that this roll is spring suspended, the elongation of the springs or the position of the roll in its guides is a direct indication of the tension being carried, and these guides could be calibrated like a spring balance from zero up if desired.

Dancer roll gave considerable tension variation

In previous instances where winders and calenders have been operated together the winder speed did not have a definite or synchronous relation to the calender, but was controlled or regulated by a rheostat driven from a counter-weighted take-up or dancer roll located between the calender and winder. With such a dancer roll the tension in the sheet is determined by the difference in weight between the counterweight and the roll. By

**Abstracted from paper presented before the Technical Association of Pulp and Paper Industry at its recent New York meeting.*

adding or removing weights it is possible to vary the tension over a considerable range, but due to the friction of pulleys or sprockets and the effort required to operate a faceplate rheostat, it is necessary at all times to maintain a wide difference in weight or, in other words, a considerable tension in the sheet in order to have the dancer roll respond rapidly to variations in paper speed. Even with friction reduced to a minimum the high inertia due to the combined weight of the roll and counterweight defeats the attempt to obtain a light tension and rapid response to changes in speed. On certain weights or grades of paper a high tension may be entirely satisfactory, but on light weight or weak sheets a very low tension may be a necessity. When winding any roll of paper it may also be found desirable to change the tension several times from the beginning to the end, and this involves the changing of weights on the counterweight.

With this new winder drive it is possible to wind with practically zero tension if desired—that is, with a slack sheet to the winder—but this tension can be adjusted from zero to a maximum in an infinite number of steps by the operation of a small control switch. Another operating feature of this drive is the ability to inch or rotate the winder slowly with the calender stopped in order to take up initial slack in the sheet and pull the spring roll to its proper position, or to turn the roll of paper or winder when tearing off paper or putting on wrappers.

Synchronization makes zero tension possible

Perhaps a clearer conception of the flexibility and ease of operation of this entire equipment can be obtained by following through the sequence of starting and winding a roll of paper. Assume, for instance, a new reel of paper in place. The drum controller of the main drive is moved to the first point, which causes the calender and winder to operate at low frequency speed. One of the small switches on the control bench is then operated, which causes the reel to unwind paper so that a "tail" may be torn off to thread through the calender. The speed is controlled by turning a rheostat, using a high speed at first, then slowing down until the paper speed is the same as that of the calender, to permit threading. All manual effort of turning or unwinding the reel is entirely eliminated and considerable time saved.

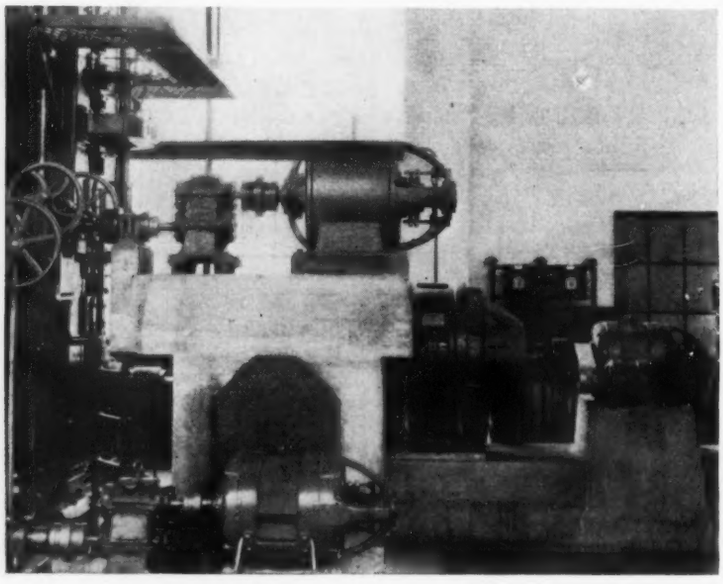
After the "tail" is well threaded and widened out further operation of the same rheostat applies as much tension in the sheet as desired and holds this tension even if the calender is stopped. The paper after leaving the calender is passed over the spring roll to the winder and properly started on the rewinding shaft. At any time while operating at low speed the unit may be started and stopped by push buttons suitably located around the machine. After dropping the rewinding shaft in place and stopping the stock the winder will probably be inched until the spring roll is in the desired position.

One advantageous characteristic of this synchronized drive is that when stopped it will not back up due to tension in the sheet, but will hold the same tension that existed when running.

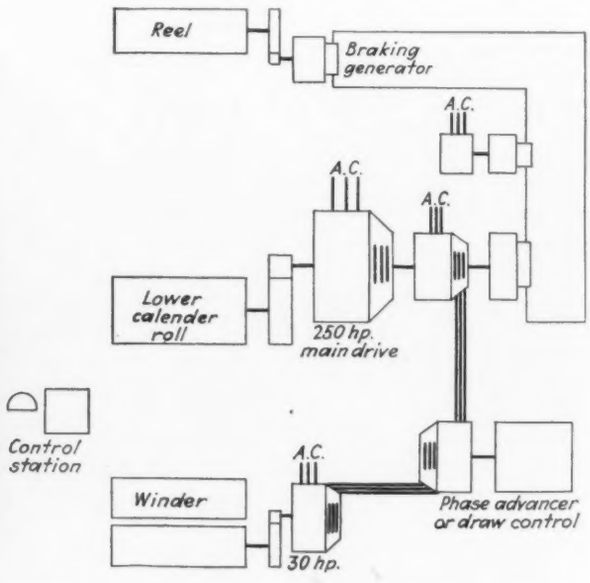
Electrical characteristics held permanently

With the sheet entirely threaded through and on the winder the operator now starts the calender again and brings it to full speed as rapidly as he desires, since no adjustments or attention need be given the spring roll or draw to winder. As soon as the calender is up to speed the operator takes a final look at the ammeter indicating the tension on the reel, makes an adjustment if necessary, then leaves the control bench to look after mechanical adjustments of the calender and winder, knowing that the electrical characteristics will remain constant until intentionally changed.

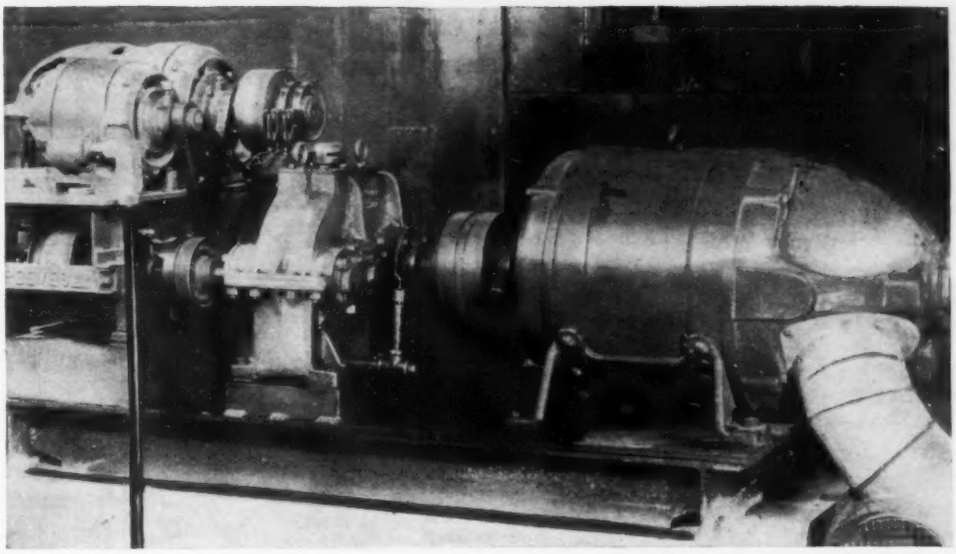
When a "flag" appears on the reel or it is desired to slow down to examine the sheet the operator simply moves the main drum master switch as rapidly or as slowly as he desires, since all tensions or draws will remain fixed and need no attention. Consequently a slowdown can be made to pass a bad spot and full speed regained in a minimum time. In a like manner the reel



Winder motor, braking generator and main drive in compact arrangement



Phase advancer and braking generator maintain synchronism and tension



Phase advancer for winder draw adjustments mounted in basement

can be run down to the core and stopped with paper in the stack, thus saving considerable paper and loss of time. In case of a break in the stack or any other emergency requiring a very quick stop a control switch with red handle is operated which connects the main motor to the low-frequency supply and applies a strong braking effort.

From the above description it is apparent that from the control bench or pulpit, as it is sometimes called, it is possible to observe and to control practically all operating functions of the calender. The operator, standing before the bench, has a good view of both the draws and can also watch the winder and the stack. Not on the control bench, but near by, are the control valves for raising and lowering the weights, also for applying steam to the sheet, so that these operations may be performed quickly and with a minimum effort. Although the various calender operations obtained from the control bench have been outlined above, the following tabulation gives in a more concise form the functions of the various switches, rheostats, etc.:

Control Functions

Main drum controller:
- Entire speed control of calender and winder.

Pistol grip switches:
- For Winder.
  - 1—On-off (relative to calender).
  - 1—Inch.
  - 1—Raise-lower (draw to winder).
- For calender and winder.
  - 1—Stop (normal or emergency).
- For braking generator.
  - 1—On-off.

Rheostats:
- For braking generator.
  - 1—Speed control as motor Tension control as generator.
- Low speed.
  - 1—Tension adjustment. Under regular control.
- High speeds.

Meters:
- 1—Main calender motor.
- 1—Winder motor.
- 1—Braking generator.

Considering the entire unit, i.e., the reel, calender and winder, the following constitute the more important characteristics or features:

Main calender motor:
- Wound-rotor induction with dual-frequency control.

Winder drive:
- Induction motors—synchronized tie.
- Draw or tension in sheet adjustable from zero to maximum in infinite number of steps.
- Winder may be rotated or inched with calender stationary.

Braking generator:
- Provides for motorizing reel to tear off or thread paper at any speed desired.
- Provides tension under manual control when threading or at standstill.
- Provides tension under regulator control at all winding or operating speeds.
- Can be reversed to unwind in either direction.

On any machine of this size and complexity the ease of operation or lack of physical effort required to perform the various operations has a very great effect on the ability of the operators to maintain a high machine efficiency and some very interesting production records bear out these conclusions. The ability to operate with very low but uniform and controlled tension also tends greatly to reduce the number of breaks and loss of production, especially on light-weight paper or on paper not uniformly dried or formed. Under such critical operating conditions the ability of a drive to function smoothly and under perfect control may mean the difference between profit or loss.

▼

Preset Lighting Developed for Ten Theater Scenes

In the lighting system developed for the new double-stage Municipal Auditorium at Long Beach, Calif., thermionic-tube control has reached a new level of accomplishment. Outstanding among the features here is an arrangement which is said to make possible for the first time the setting up by the operator of lighting combinations at predetermined intensities for ten scenes in advance of a performance.

With this arrangement it is necessary to operate only one simple control when it is desired to change from one lighting effect to the next. Each circuit has a scene fader which makes it possible to blend one scene into the next with a gradual transition. If it is desired to flash suddenly from one scene to another, this may be accomplished merely by pushing a button. Immediately the lighting changes from one preset to the combination of colors chosen for the next, and the circuits respond with the required intensity.

The board for the two auditoriums has 72 controlled circuits for stage and house lighting and 30 switch circuits for miscellaneous lighting. Colors are in combinations of white, blue and red, and the stage lighting is controlled from a portable switchboard mounted on wheels. Westinghouse engineers say the lighting facilities are so flexible that any intensity of any coloring may be obtained for any kind of a production.

Frequency and Tie-Line Load Control

By PHILIP SPORN and V. M. MARQUIS
American Gas & Electric Company

Operating experience to date indicates that the bridge-type controller is somewhat more flexible but not quite so well adapted to parallel operation as the pendulum type. Before a definite opinion can be given it will be necessary to obtain further experience with the parallel operation of controllers installed in widely separated stations.

Theory and operating experience point toward the necessity of frequency control in each area. In general where automatic tie-line control is needed it should be used to supplement automatic frequency control.

The next necessary step indicated in interconnected system operation is the installation of automatic frequency control in each area of the interconnected system. General application of automatic frequency and load control will bring to the front several new problems, but it is felt that no special difficulties should arise in the solution of these problems if advantage is taken of the advances in the boundaries of actual knowledge as these boundaries are extended.

TO REGULATE frequency effectively from only one point on a large interconnected system the co-operation of the interconnected companies in caring for their own system loads is absolutely essential at all times. Experience has shown that with one-point regulation any system generating deficiency or excess is reflected to the regulating station, thus upsetting tie-line loadings. Even when each interconnected company holds reasonably good tie-line loading the summation of variations introduced by all interconnected companies still causes undesirable swings on the regulating station.

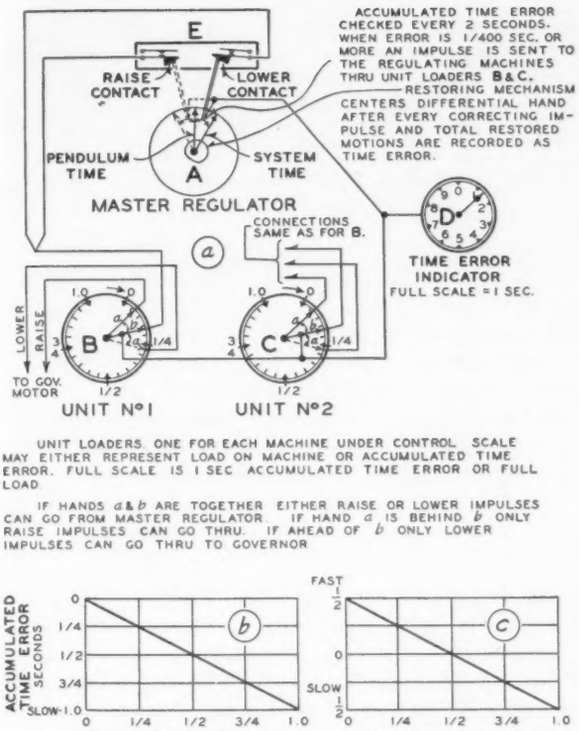
This situation suggested the desirability of reverting to an equivalent of the long-standing practice of keeping every machine on its governor. The logical method of doing this seemed to be the application of automatic frequency control at many points on the system. Therefore arrangements were made with two manufacturers to try out each one's type of equipment at each of at least three stations on the interconnected system. The two types of controllers picked out were the pendulum or time-deviation type and the tuned-bridge or instantaneous type (Figs. 1 and 2). The first question to be answered was whether or not each type of controller was adapted to parallel operation. It seemed that it should be possible to determine this with three stations located in the same area. With this question satisfactorily answered it was felt that the next logical step would be to operate controllers in parallel on two large areas connected by a tie line.

The accompanying discussion relative to basic principles of these controllers and operating results obtained with them is not given with the idea of passing final judgment upon either type. Nor is it intended to convey the idea that either type represents a final and perfected piece of equipment. It is our idea rather to give the results of experience to date with the hope that it will help speed up the solution of a most important problem.

A comparison of the basic principles of the two types of controllers selected is given in Table I; some of the comments should be elaborated. It is obvious that the ability of either type of controller to operate in parallel depends to a great extent upon the accuracy of the standard. Previous to actual parallel operation, a theoretical analysis of the two types led to the conclusion that reasonably accurate pendulums would parallel more satisfactorily than tuned bridges. This conclusion was based mainly on experience with tuned-bridge frequency recorders.

While the bridge-type recorders served admirably for indicating frequency, nevertheless it was realized that they were subject to errors and that no two of them could be adjusted to exactly the same limits. It appeared that any attempt to parallel two devices of the tuned-bridge type would be equivalent to trying to parallel two prime movers having flat speed-load characteristics, and that even slightly different sensitivity would lead one controller to take all the minor load fluctuations. On the other hand, it was known that a standard pendulum could be expected to keep within one second a day of correct time, and on the assumption that two pendulums were to be paralleled the rate of transfer of load between regulating units due to pendulum error did not seem to be an objectionable factor. For example, if the regulating units are loaded on the basis of a second time error deviation and during the course of a day, one of the pendulums varied from true time by one second, while the other pendulum kept exactly correct time, then it would take 24 hours for the one station having the pendulum in error to transfer its regulating load in the wrong direction. How this theory actually worked out in practice will be discussed later.

Considering time deviation, it is evident that with either type of controller there must be some accumulated time error since time is required for correcting impulses to change system speed. During this interval the system has gained or lost a certain amount of time, depending on whether the frequency was high or low. With the bridge-type controller the time deviation depends upon the sensitivity of the controller (that is, whether it is set to detect, say, 0.01 or 0.05 cycle) and upon the length of the impulse sent to the governor. Both of these factors may be varied. However, it is not possible without special tests to determine just what the time deviation will be for any definite set of adjustments of the instrument.


E
RAISE CONTACT
LOWER CONTACT
ACCUMULATED TIME ERROR CHECKED EVERY 2 SECONDS. WHEN ERROR IS 1/400 SEC. OR MORE AN IMPULSE IS SENT TO THE REGULATING MACHINES THRU UNIT LOADERS B&C.
RESTORING MECHANISM CENTERS DIFFERENTIAL HAND AFTER EVERY CORRECTING IMPULSE AND TOTAL RESTORED MOTIONS ARE RECORDED AS TIME ERROR.
PENDULUM TIME
SYSTEM TIME
A
MASTER REGULATOR
CONNECTIONS SAME AS FOR B.
a
D
TIME ERROR INDICATOR
FULL SCALE = 1 SEC.
LOWER
RAISE
TO GOV. MOTOR
B
C
1/2
1/4
UNIT N°1
UNIT N°2
UNIT LOADERS. ONE FOR EACH MACHINE UNDER CONTROL. SCALE MAY EITHER REPRESENT LOAD ON MACHINE OR ACCUMULATED TIME ERROR. FULL SCALE IS 1 SEC. ACCUMULATED TIME ERROR OR FULL LOAD.
IF HANDS a & b ARE TOGETHER EITHER RAISE OR LOWER IMPULSES CAN GO FROM MASTER REGULATOR. IF HAND a IS BEHIND b ONLY RAISE IMPULSES CAN GO THRU. IF AHEAD OF b ONLY LOWER IMPULSES CAN GO THRU TO GOVERNOR
ACCUMULATED TIME ERROR SECONDS
FAST
SLOW
b
c
LOAD ON REGULATING UNIT.
LOADER SET TO GIVE 1/2 LOAD ON REGULATING UNIT FOR 1/2 SECOND ACCUMULATED TIME ERROR.
LOADER SET TO GIVE 1/2 LOAD ON REGULATING UNIT FOR 0 SECOND ACCUMULATED TIME ERROR.

Figs. 1 a, b, c—Schematic diagram of pendulum-type frequency controller and typical time-error-load characteristics

Since load changes in any power system must of necessity* be accompanied by at least temporary speed changes and therefore by some time-error accumulation, it seems reasonable that accumulated time error could be used as a basis for loading machines to hold frequency within very close limits. The pendulum controller† Fig. 1a makes use of time error as a basis for controlling speed giving the characteristic shown in Fig. 1b. Each frequency controller has a drooping characteristic similar to the ordinary prime mover governor. This fact should insure proper parallel operation of the controllers as it does in the case of prime movers. The loading characteristic shown in Fig. 1c is entirely possible and practicable.

This type of controller uses a pendulum as a secondary standard (the primary standard being Arlington time) and system time is compared against this pendulum. This comparison is made every two seconds and when the accumulated time error is 1/400 second or more impulses are sent to the regulating machines from the master regulator through the unit loaders B and C. The time-error detecting mechanism is restored after each two-second check. The accumulated time error is recorded on an indicating meter and also on the time-error hand "b" of the unit loaders. The scale on the unit loaders may be divided in either seconds or kilowatt load on the unit to be regulated. Hand "a" represents load on the generator; this may be indicated either as kilowatt output directly, or indirectly, by representing the valve position.

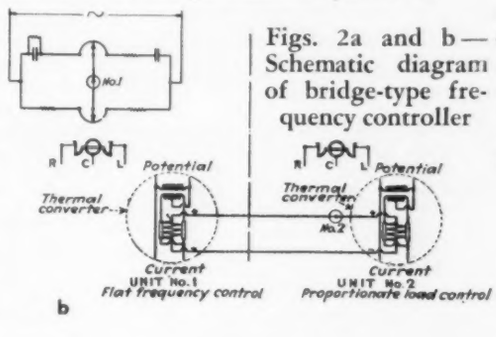
On each of these two-second checks if there is a sufficiently accumulated time deviation, raising or lowering impulses (depending on whether system time is ahead or behind pendulum time) are sent by means of the proportional-step device "E" to the governor motors. The duration of the impulse is proportional to the amount of time deviation. The unit loaders B and C act as filtering devices between the master regulator and the regulated machines to keep the load properly balanced on these regulating machines. Attempt to "overshoot" the loading (in either direction) on any machine will temporarily open the unit loader circuit and no further impulses can go through until the accumulated error has again deviated.

A unit loader is used for each machine under control, which results in keeping the loads balanced on all units. The criterion for minimum duration of the impulse to be sent to the governor motor is that it shall be sufficiently long so as to make it possible for the prime mover having the slowest governor to match the time-error hand "b." The load may also be shifted on the units by manually adjusting the individual time-error hand "b" or by adjusting the synchronizing motor directly.

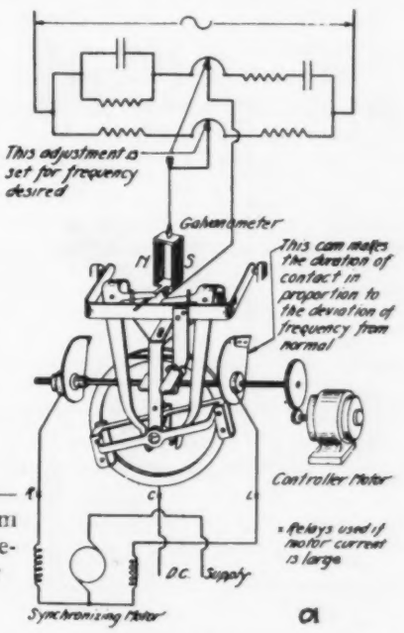
Fig. 2a and b show schematic diagrams of the tuned-bridge type controller. This device is somewhat similar in construction to the familiar bridge-type frequency recorder. The device is sensitive to frequency variations of the order of 0.01 cycle. When the frequency varies from the control setting the controller galvanometer is deflected in one direction or the other, depending upon the magnitude of the unbalanced current through the bridge. The direction of this current is dependent upon whether the frequency is high or low. The deflection of the galvanometer pointer is picked up by the controller mechanism and closes contacts which operate the governor-synchronizing motor. The controller is so designed that the duration of the impulse sent to the governor motor is directly proportional to the amount of deviation of frequency from the control setting.

When it is necessary to have more than one unit under frequency control the loads may be leveled by using a scheme such as shown in Fig. 2b. One unit is placed directly on frequency control, while the additional units are connected on a separate controller with proper arrangement for load leveling. A Lincoln thermal converter is placed on the unit directly on frequency control and on each of the additional units. This instrument operates similarly to a wattmeter except that instead of indicating the load it produces a low-voltage d.c. potential that is proportional to watts and is thus independent of power factor.

The galvanometer in No. 1 unit is in the frequency bridge and varies the load on the machines which it is controlling in such a way as to maintain system frequency. As the load increases on unit No. 1 and becomes greater than on unit No. 2 galvanometer on unit No. 2 will indicate an unbalance. This deflection of the galvanometer will cause controller No. 2 to operate in such a way as to increase load on the machine it is controlling and level the loads on the two machines. Any slight unbalance in loading between the two units will cause the second unit to readjust its load until equal to that of the frequency-control unit. If other regulating units are added, the potentials of their thermal converters are likewise balanced against the frequency-controlling unit as shown for unit No. 2; there are no limitations to the number of units at one station that can be thus controlled in parallel from one frequency controller.



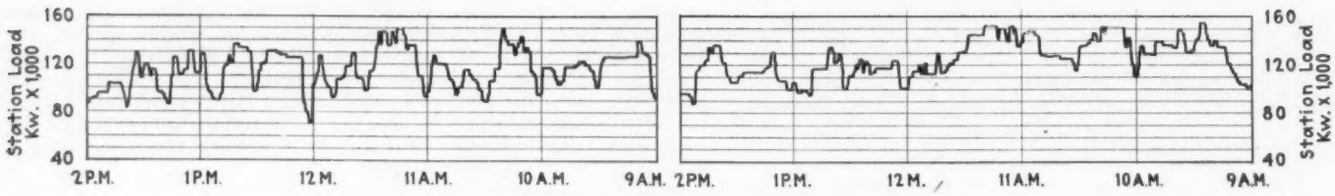
Figs. 2a and b—Schematic diagram of bridge-type frequency controller


This adjustment is set for frequency desired
Galvanometer
N
S
This cam makes the duration of contact in proportion to the deviation of frequency from normal
Controller Motor
* Relays used if motor current is large
D.C. Supply
Synchronizing Motor
a

(a) Applies when connected for control of a single generator; (b) applies when several generators in same station are on frequency control. One machine is on straight frequency control and additional units on proportionate loading.

*ELECTRICAL WORLD, page 495, March 12, 1932.

†ELECTRICAL WORLD, page 1072, May 3, 1930, "Controlling Load, Maintaining Frequency," by D. M. Jones. See also *General Electric Review*, page 309, June 19, 1929, "Automatic Control of Frequency and Load," by H. A. McCrea.



Figs. 3 and 4—Before and after applying parallel control

At left is the load on the regulating station with automatic frequency control at this station only. At right is the load on the same station but with two other stations having capacity on automatic frequency control

The bridge-type controller will detect frequency variations of the order of 0.01 cycle; that is, it will not detect any change between 59.99 and 60.01 cycles. This "dead band," of course, means time deviation. For example, if the frequency were consistently 0.01 cycle high for a period of one hour, the time deviation from this cause alone would be 0.6 second, or if the frequency were consistently high for 24 hours the time error would be 14.4 seconds. However, over the period of a day the effect of this "dead band" may not be noticeable, since in all probability the system frequency will be between 59.99 and 60 as much of the time as it will be between 60 and 60.01.

The pendulum-type controller records time deviation and uses it as a basis for loading the regulation units, therefore time will never deviate more than the basic rate of loading. If the regulating units are loaded on the basis of one second, time deviation will never be more than one second, provided there is sufficient capacity under the control of the frequency regulators.

Each type of controller has the proportional-step feature. The bridge-type controller sends to the governor-synchronizing motor impulses whose durations are proportional to the variation of the system frequency from 60 cycles. The pendulum type sends impulses of a duration proportional to the magnitude of time error.

It will be noted from the description of the two equipments (Figs. 1 and 2) that each uses a different method for leveling load on units where more than a single machine is under control in any station.

By adjusting the duration of impulses to the governor motor the tuned-bridge type controller will hold practically constant frequency within the limits of the units under control. The pendulum type will not necessarily hold constant frequency since in the normal setup it requires a one-second time deviation to put full load on the regulating unit. Thus the frequency could be low by $\frac{1}{10}$ cycle for ten minutes $\frac{\frac{1}{10} \times 60}{60} 10 = 1$ second before the machine would transfer load over its entire regulating range (assuming it was at its lower regulating limits at the start). This is overcome as additional capacity is placed under control. The only means for changing this characteristic with limited capacity under control is by changing the basis of loading. For example, if one-half second is used as a basis of loading, then the low frequency would persist five minutes, etc. Thus if sufficient swing is allowed on a single unit or station and the unit or station is big enough the bridge-type controller will maintain frequency within the limits of accuracy of the bridge, while the pendulum type as normally set inherently requires more capacity under control, although not more capacity change, to give a definite grade of control.

Lights are used in each station to indicate when raise and lower impulses are being sent to the governor motor by the frequency controller. Usually there is a set of lights for each generator under control. In each case two lamp circuits are connected so that one or the other will be energized, depending on whether raise or lower

Table I—Comparison of Basic Principles of Two Types of Controllers

Basis of Comparison	Bridge or Instantaneous Type	Pendulum or Time Deviation Type
Standard	Tuned bridge circuit	Pendulum
Accuracy of standard	Depends on remnant errors and stability of bridge and galvanometer. Accuracy probably of order of one part in 10,000.	Accumulated pendulum error may total one-half to one second per day, or, roughly, one part in 100,000.
Sensitivity	Will detect frequency deviation of the order of 0.01 cycle.	Will detect 1/400-second deviation. In terms of instantaneous frequency, this means there must be an average deviation of about 0.07 cycle (for 60-cycle system) over the two-second period in order to be detected.
Basic principle of operation	Attempts to hold close instantaneous frequency and in so doing expects to hold time deviation to a minimum.	Attempts to hold time deviation to within set limits and in so doing expects to hold instantaneous frequency very close to normal.
Method of operation	Checks instantaneous frequency every two seconds and sends an impulse of a duration proportional to instantaneous frequency deviation.	Checks accumulated time error every two seconds and sends an impulse of a duration proportional to the accumulated time deviation.
Requisites for proper parallel operation	Requires same zero settings, proper stability of bridge circuits and galvanometers, and similar speed or translation of current variations in bridge circuits into impulses to the governor-synchronizing motors. Constant and similar accuracy of tuned bridge is essential. Depends on changing load proportionately by proportioning impulse at the different points under regulation for the same deviation in frequency.	Requires similar pendulums. Depends on load-time deviation droop characteristic properly to divide load between all regulating stations. Requires similar speed of translation of time deviation into impulses to the governor-synchronizing motors.
Proportionate loading of machines in same station	One machine directly on frequency control. Others follow by balancing their load against the load of the directly controlled machine.	Individual machines loaded by individual unit loaders having similar load-time deviation droop characteristic, and all are actuated by common time deviation measuring device.
Rate of load transfer	Depends on duration of impulse sent to the synchronizing motor for each unit of frequency deviation. This feature adjustable within limits.	Depends on duration of impulse sent to the synchronizing motor for each unit of accumulated time deviation as definite predetermined rate of load transfer. Rates used heretofore have been on basis of one-half and one second of accumulated time error to cover allowable range of load on regulating units. Thus, if frequency drops 1/10 cycle full load would be transferred if frequency stood 1/10 cycle low for ten minutes in case of a one-second loading basis, and if it remained 1/10 cycle low for five minutes in case of a one-half-second loading basis.

impulses are being sent to the governor-synchronizing motor. It is the usual practice to connect them so that a red light indicates when the controller is attempting to raise the frequency and a green light indicates when the controller is attempting to lower the frequency.

Operating experience with parallel automatic frequency controllers

Considerable experience has now been acquired with parallel operation of both types of controllers at three generating stations. Figs. 3 and 4 show the Windsor output before and after parallel control was attempted. It is of interest to note the decrease in magnitude of load swings on Windsor station, especially during the rapidly load-changing period. The other stations were set so that they would together take about the same swing as Windsor. These results furnished convincing proof that multi-frequency control was a step in the right direction in so far as reducing the burden on any one station was concerned.

The experience with the tuned-bridge controller showed that, contrary to the expectations of some, it was capable of operating in parallel. Actual parallel operation did, however, bring to light the following points with regard to it:

(a) This type controller has a vernier adjustment for varying the sensitivity of the instrument over a small range in either direction from normal frequency. The zero setting should represent normal frequency, but it was found that no two controllers had exactly the same sensitivity; that is, it was not possible to set two or more of the controllers at the 60-cycle point, as indicated by the dial, and get proper parallel operation. This depends upon the "remnant" errors in the bridge circuit and galvanometer and upon the inherent stability of the bridge circuit. In adjusting the controllers so that they will measure plus or minus 0.01 cycle variation from 60 cycles it is evident that the probable indeterminate error is greater than the differences that we were attempting to compare. Slight changes in sensitivity occur and compensating adjustments are required from time to time. Experience has shown that by the trial-and-error methods (by checking lights, etc.) the verniers could be adjusted to give satisfactory parallel operation over the periods controllers were operated in parallel (periods of twelve hours or so).

(b) It was also found that there is a tendency for the galvanometer to get out of mechanical adjustment; experience has shown this to be especially true where there is excessive vibration. Spring mounting* and proper maintenance do, of course, greatly minimize this difficulty.

(c) In order for the instruments to be paralleled, it has been found necessary for the operator to set the dial at normal frequency for the incoming station, then get in touch with the other station by telephone and adjust the controller sensitivity until the indicating lights on this incoming controller are in synchronism with the station already under control. Or the operator in the incoming station may vary the dial setting on the controller until his tie-line loading is correct. The latter method may result in simply biasing the incoming station controller so that the "dead band" is widened.

(d) It was felt that the real test for this type equipment would be obtained in stations sufficiently separated so that telephone communication would not be readily available. On this basis the operators in two of the stations were requested to determine if they could parallel the controllers without using the telephone or indicating lights. It was found that the incoming stations, after considerable shifting of the controller sensitivity, could finally get satisfactory operation by observing tie-line load. It is obvious that with a normal system setup this might be a dangerous criterion.

(e) Experience has shown that this type controller will hold a very close frequency line. However, even with only one station controlling frequency, it is necessary to adjust the bridge sensitivity several times each day in order to keep the time deviation within, say, a plus or minus two-second limit. With these adjustments, however, this type equipment is ideal for regulating frequency at one point only on the system and where a very close frequency line is required.

(f) It is felt that additional experience is required with stations widely separated to determine definitely the paralleling qualities of this type of equipment.

Operating experience with the pendulum type of controllers in parallel brought out the following:

(a) This type is especially well adapted for parallel operation. The pendulums are sufficiently accurate so that the tendency for one station to "grab" load is not an important factor.

(b) It is necessary to check pendulums daily against Arlington (or some common standard) and that adjustments be made occasionally to correct for any errors that might otherwise accumulate.

(c) It is a very simple matter for a second station to go on automatic control. It is simply a matter of closing the control

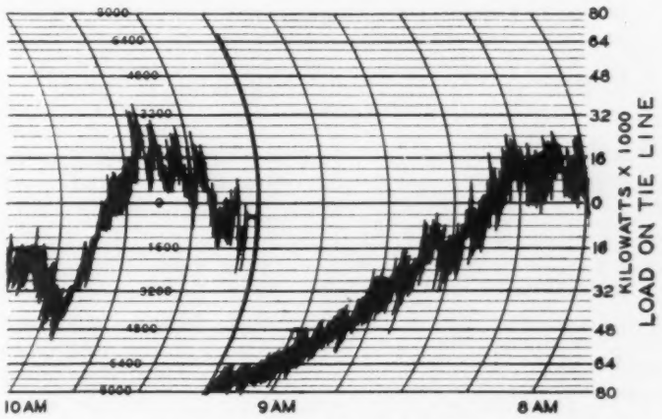


Fig. 5—Tie-line load with bridge-type frequency controllers at stations at each end of line
Controllers set for slightly different sensitivity

circuit; no adjustments are necessary to be sure that the second controller is in step with the one already in service in another station.

(d) This type of controller is not satisfactory for operation on limited capacity if a very narrow frequency band is to be held. The frequency variation can be reduced by reducing the time deviation used as a basis of loading. The basis may be reduced from, say, one second to one-quarter second. However, if controllers are operating in parallel on the latter basis pendulum errors would cause load shifts four times as fast as in the former case (one-second basis).

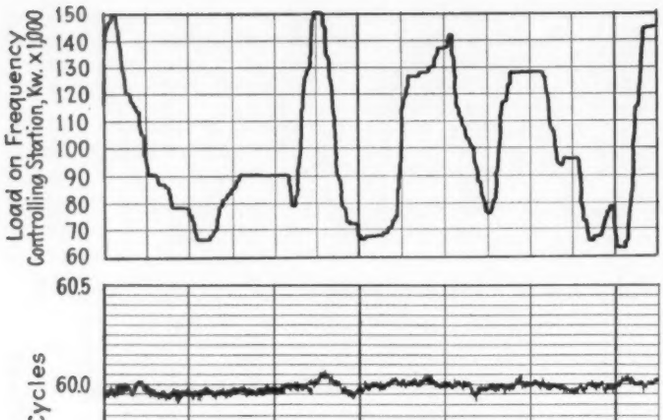
(e) The equipment has not been operated over a sufficiently long period to permit an opinion as to whether or not mechanical troubles will develop in the controller mechanism.

(f) With many of these controllers in parallel in widely separated stations some plan for load dispatchers in various areas systematically checking time error and pendulum performance would have to be established. This should only be necessary, say, once each day and should not offer any particular difficulty.

In order to hold a narrower frequency band with the pendulum-type controller the basis of loading on the main regulating station was changed from one second to one-half second. While this resulted in less frequency deviation it is felt that a better solution would be to place more capacity under control and adopt a one-second basis of loading.

It was found that additional flexibility was required with the pendulum-type controller in order to be able to gain or lose time. This was mainly because of insufficient capacity under control, with the result that considerable time was usually lost during heavy load periods. A time bias was added so that time could be gained or

*Langstaff and Reardon, "Frequency Control Mounted to Minimize Vibration," "Electrical World," page 113, July 18, 1931.



Figs. 6 and 7—Example of station loading with bridge-type frequency control and corresponding frequency

lost at the rate of one second per hour. Regardless of type of controllers and degree of saturation of the system with controllers this feature is desirable. On the bridge type it merely means changing the sensitivity setting so as to hold a slightly higher or lower frequency, as the case may be.

Fig. 5 illustrates a case in which two bridge-type frequency controllers, known to be of different sensitivities, were operated in parallel on two large interconnected areas. This is shown merely to illustrate the load transfer that occurs between regulating stations if the frequency controllers, no matter what type, have different degrees of sensitivity.

It is obvious that with either type of controller it would be advantageous, in so far as parallel operation of controllers is concerned, to have all controllers synchronized by some primary standard frequency.

It is of interest to study the loading of a station when under the two types of control. Fig. 6 shows station loading with the bridge-type controller and Fig. 7 the corresponding frequency chart. Fig. 8 shows station loading and Fig. 9 corresponding frequency chart with pendulum-type control. While it is very difficult to draw any definite conclusions from such records, nevertheless it is believed that they do show the characteristics of each controller. It may be observed that the bridge-type controller gives a load transfer rate very much higher than the pendulum type. The effect on the boiler room conditions is very noticeable. Experience shows that if reasonable time is permitted (such as in the case shown in Fig. 8) it is possible for the boiler room to follow the load changes. But with very rapid changes, such as in Fig. 6, the problem is difficult and results in popping boilers, low steam pressure, etc. It will be noted that the frequency line is held within a narrower band with the bridge-type controller. Here again it is possible to adjust the bridge type so that the sudden rate of load transfer could be reduced at the expense of a wider frequency deviation. It must be borne in mind that the bridge-type controller was set to hold frequency and was shifting station load throughout its load range to hold flat frequency. Regardless of the type of controller, the proper way to reduce swings on an individual unit or station is by placing more capacity, properly distributed, under automatic regulation.

It is difficult to derive a formula for the amount of capacity required for frequency control. However, a consideration of fundamentals will give a rough estimate of the capacity needed. For example, consider a system of 3,500,000 kw. capacity with all machines initially operating at the same load and having 4 per cent governors; assume that a load change of 150,000 kw. takes place; how much will the speed drop if no manual adjustments are made on any prime-mover governors?

$$\Delta p = \frac{\Delta f}{\text{normal frequency}} \times \frac{\text{system capacity}}{\text{governor regulation}}$$

Where:

Δf = Speed change

$\frac{\Delta f}{\text{normal frequency}}$ = per unit speed change

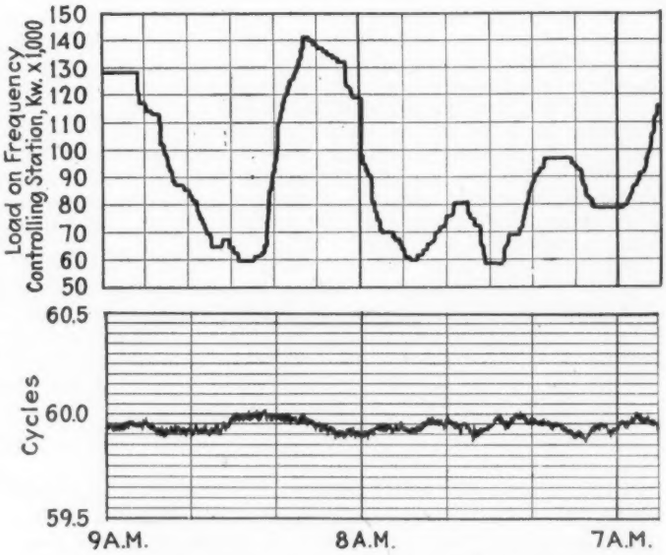
Δp = Load change = 150,000 kw.

$$150{,}000 = \frac{\Delta f}{60} \times \frac{3.5 \times 10^6}{0.04}$$

Δf = approximately 1/10 cycle.

or $\frac{1}{10}$ cycle change represents roughly 4 per cent load change on the system.

A consideration of the fundamental characteristics of the two types of controllers will show that each inherently requires different amounts of capacity under regulation to maintain frequency. The bridge-type controller should hold practically flat frequency if applied to 4 or 5 per cent (150,000 kw.) of the total capacity in the case just cited. The pendulum type operating on a loading basis of one-second deviation will inherently require more capacity than 4 per cent under regulation to maintain a constant frequency line. If, in the case mentioned, the frequency variation of $\frac{1}{10}$ cycle persisted for one minute the accumulated time error would be $\frac{1}{10}$ second. Or if 150,000 kw. were under control the load change to maintain frequency would be only $\frac{1}{10} \times 150{,}000$ or 15,000 kw. Thus to give



Figs. 8 and 9—Example of station loading with pendulum-type frequency control and corresponding frequency

the required 150,000 kw. change some 1,500,000 kw. should be under regulation.

This reasoning neglects certain factors, so that it seems reasonable to say that 20 to 30 per cent of the system capacity should be under control to maintain frequency with the pendulum-type controller. This does not mean that any one machine or station would shift a large amount of load, but rather that each machine would take a very small shift in attempting to maintain frequency. The alternative with the pendulum-type controller is to use a smaller amount of capacity and use a narrower time deviation band as a basis for loading.

With either type of control a considerable percentage of the total capacity should be under control in order to reduce the swing on any one machine or station, for if the load shift is sufficiently small the operating efficiency of any unit will not be impaired.

Place of tie-line control in operation of interconnected systems

It is impossible to proceed very far with a discussion of this general subject before the question of tie-line control arises. This is especially true where very rigid contractual relations have been set up between systems.

The ideal setup would be that, during normal conditions, each interconnected system should take care of its own load fluctuations and outside contract requirements and carry on as though it were not tied in with the rest of the system. At the same time the interconnection should be such that in time of emergency on any one system maximum help can be received from the interconnection. Those in close contact with the operation of large interconnected systems have already realized that this is a large order.

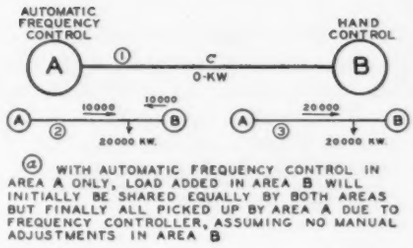
Two fundamental schemes have been suggested for applying automatic control to carry out this plan:

(a) This plan proposes to use tie-line control (initiated by tie-line kilowatts or phase angle) on all tie lines between areas and to hold frequency by some small regulating machine at a centrally located point.

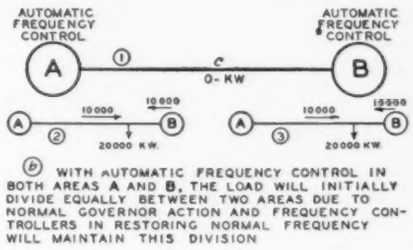
(b) The second plan proposes to give to each area automatic frequency control and to supplement this by tie-line control wherever necessary.

Reasoning from fundamental principles of load distribution among a group of prime movers operating in parallel it is possible to deduce what logically may be expected with various combinations of automatic frequency and automatic tie-line control.

Consider two areas each having equal generating capacity, equal loads and all prime movers having the same governor characteristics. Referring to Fig. 10a, assume that area *A* has automatic frequency control and area *B* hand control. If a 20,000-kw. load is added in area *B* it will at the first instant be shared equally by the two systems due to the stored energy of the systems. The speed will drop slightly and all governors will open the prime mover throttles to increase the input, but this pickup in load will be accompanied by a drop in system speed. The frequency controller in area *A* will, of course, detect the drop in speed and before *B* can adjust manually all the load will be picked up by area *A*. (The three steps in which this will take place are shown in Fig. 10a.) With the speed back to normal the governors in area *B* will be back to the position they had before the load change took place.


AUTOMATIC FREQUENCY CONTROL
HAND CONTROL
A
B
C
0-KW
10000
20000
20000 KW.
20000 KW.
(a) WITH AUTOMATIC FREQUENCY CONTROL IN AREA A ONLY, LOAD ADDED IN AREA B WILL INITIALLY BE SHARED EQUALLY BY BOTH AREAS BUT FINALLY ALL PICKED UP BY AREA A DUE TO FREQUENCY CONTROLLER, ASSUMING NO MANUAL ADJUSTMENTS IN AREA B

Figs. 10a and b—Load transfer with automatic frequency control in one area and in two areas
(See text for discussion)


AUTOMATIC FREQUENCY CONTROL
AUTOMATIC FREQUENCY CONTROL
A
B
C
0-KW
10000
20000 KW.
20000 KW.
(b) WITH AUTOMATIC FREQUENCY CONTROL IN BOTH AREAS A AND B, THE LOAD WILL INITIALLY DIVIDE EQUALLY BETWEEN TWO AREAS DUE TO NORMAL GOVERNOR ACTION AND FREQUENCY CONTROLLERS IN RESTORING NORMAL FREQUENCY WILL MAINTAIN THIS DIVISION

Figs. 11a and b—Load transfer with automatic frequency control in one area and automatic tie-line control in another area
(See text for discussion)

Fig. 10b represents the case with automatic frequency control in both areas. A load change of 20,000 kw. in area *B* will initially result in 10,000 kw. from each area. The same drop in speed takes place as in the case previously discussed. The frequency controllers detecting the drop in speed bring it back to normal with each area still furnishing 10,000 kw. Thus, with frequency control in each area the load transfer across the tie line has been reduced to one-half of that with automatic frequency control in one area only.

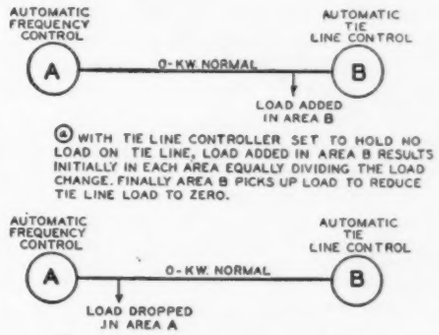

AUTOMATIC FREQUENCY CONTROL
AUTOMATIC TIE LINE CONTROL
A
B
0-KW NORMAL
LOAD ADDED IN AREA B
(a) WITH TIE LINE CONTROLLER SET TO HOLD NO LOAD ON TIE LINE, LOAD ADDED IN AREA B RESULTS INITIALLY IN EACH AREA EQUALLY DIVIDING THE LOAD CHANGE. FINALLY AREA B PICKS UP LOAD TO REDUCE TIE LINE LOAD TO ZERO.
AUTOMATIC FREQUENCY CONTROL
AUTOMATIC TIE LINE CONTROL
A
B
0-KW. NORMAL
LOAD DROPPED IN AREA A
(b) WITH TIE LINE CONTROLLER SET TO HOLD NO LOAD ON TIE LINE, LOAD DROPPED IN AREA A GIVES EXCESS GENERATION RESULTING IN HIGH FREQUENCY AND POWER FLOW TOWARDS B. B PICKS UP LOAD TO REDUCE TIE LINE LOAD TO ZERO AND IN SO DOING OPPOSES FREQUENCY CONTROLLER IN AREA A. TO REACH FINAL ADJUSTMENT UNNECESSARY POWER DRIFTS HAVE OCCURED BETWEEN A AND B.

Fig. 11a represents the case of automatic frequency control in one area with automatic tie-line control at the other end of the tie line. Assume the tie-line controller is set to hold zero load on the tie line. If load is added in area *B* the load will first be divided equally by the two areas and finally the tie-line controller will cause area *B* to pick up the entire load and reduce the tie-line load to zero. Now assume load is dropped in area *A* (Fig. 11b). This means excess generation in area *A* and power will again flow toward area *B*, as it did in the previous case. Area *B* will try to pick up load to reduce the tie-line load to zero, but in so doing is acting in a direction to oppose frequency, since frequency is already high; in other words, load pickup by area *B* due to high frequency tends to raise it still more. During this period the frequency controller in area *A* is trying to reduce the frequency. However, in getting the tie-line load back to the proper value there have been unnecessary load transfers across the tie line, resulting in additional burden on the frequency-regulating station.

The cases discussed are, of course, hypothetical and somewhat different from actual practice due to the many variables not considered. However, the reasoning for

the cases assumed is fundamentally sound. It is believed that if on a large interconnected system frequency were maintained automatically at one point and automatic tie-line control were used on all tie lines the frequency-regulating station would continue to get heavy load changes during rapidly changing load periods.

All this may be summarized as follows:

(a) With automatic frequency control at one point only there must result a transfer of power across tie lines to the regulating station which may become excessive during rapidly changing load periods on large interconnected systems.

(b) Automatic frequency control on each of two areas connected together by a tie line will result in each area taking a portion of load changes no matter where they occur. This will therefore reduce the magnitude of power transfer across tie lines. It will also reduce the number of reversals of transfer across the tie and will lessen the burden on any one regulating station. The fact that each area will take a portion of the load change no matter where it originates may result, however, in upsetting contractual relations on the tie line.

(c) Automatic frequency control in one area and automatic tie-line control on the interconnecting tie line in a second area result in improper operation for certain load changes, since the tie-line controller cannot differentiate between adding load in its own area and the dropping of load in the area having automatic frequency control.

(d) Automatic frequency control in each area, supplemented by tie-line control where necessary, would seem to offer a practical solution of the problem. With this arrangement the automatic tie-line controller could be made to operate in the right direction to aid in maintaining frequency always. When the tie-line limit is exceeded the frequency controller in one area could be made inoperative until the tie-line controller had properly adjusted the tie-line load. Such a setup would assure proper frequency regulation in each area.

Parts of problem still requiring solution

It is not intended to assert definitely that the experience outlined and the steps suggested will give the final and complete solution to the problem. On the contrary, new problems are more likely to arise. Those problems given below will have to receive further attention:

(a) The proper co-ordination of plant loading within each system.

(b) The development of the controllers so as to hold normal power flow within reasonable limits of set values (these will generally be determined by contractual requirements) and yet permit free power flow or interchange in emergencies.

(c) The problem of tie-line control where multiple tie lines are used between systems.

(d) The proper co-ordination of tie-line and frequency controllers in any given and adjacent areas so that the two function toward the same end with a minimum load swing and so that the functioning of one does not vitiate some prime function of the others or of the system at a time when such functioning is badly needed for proper system performance.

The necessity of giving attention to these matters in the future ought, however, to be no deterrent to carrying out that part of the job which is definitely indicated as possible at the present time. The difficulties that are likely to be encountered in this case are no different from what generally happens in other problems as complex as this. There seems to be no doubt that equipment now available, if properly applied, will give a satisfactory solution of a part of the problem and will result in a more equitable division of regulating capacity than now exists generally on interconnected systems. In time the remaining difficulties will also be cleared up. If the benefits that interconnection confers in the operation of large power systems are real, as most people believe they are, then there ought to be no hesitancy in tackling these difficulties as they come along.

Jewel Bearings Protected During Meter Handling

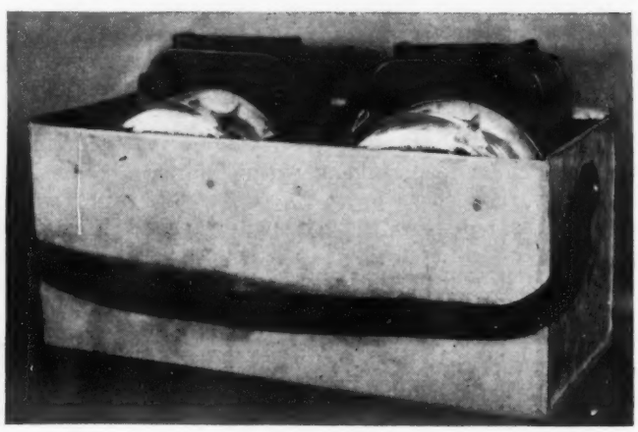
By FRED HAITZ, Jr.

Sioux City Gas & Electric Company, Sioux City, Iowa

To prevent damage to lower bearings while watt-hour meters are being transported to their places of installation, the Sioux City Gas & Electric Company uses the low cost, but perfectly adequate, carrier shown in the accompanying illustrations. When one considers that lower bearing pressures as high as 27 tons per square inch are not uncommon in modern watt-hour meters, it is apparent that means should be provided to guard against cracking or chipping the highly polished jewel surfaces during meter handling.

The outstanding feature of this tray is that it holds the meters in an inverted position and the pivots fall away from the jewels. In this position it is quite impossible to do any damage. The meter rests on a V-shaped felt-padded block that conforms to the shape of the instrument regardless of its diameter or size. Two of these

No danger of meter jewel damage in these carriers



blocks are placed in each tray. The tray itself is constructed of galvanized sheet iron lined with press board and contains a removable partition between the meters. A leather strap facilitates carrying. These trays are set in special compartments in the service trucks or placed in among the tools without fear of damage to meters.

Rectifier Avoids Need for Electrification Frequency Conversion

By OTHMAR K. MARTI*
Engineer-in-Charge Rectifiers and Railway Equipment, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Grid-controlled mercury-arc rectifier in conjunction with new commutatorless motor makes 60 to 25 cycle conversion unnecessary

DURING the last few years the mercury-arc rectifier has influenced the electrification of railroads to a very great extent because of its ability to convert a.c. to d.c. power at high voltages and with a high degree of economy and reliability. Now the rectifier may give a new impetus to railroad electrification, for it is now possible, by the use of a commercial mercury-arc rectifier equipped with grid control, to build a commutatorless motor which does not require the elaborate and costly switching, reversing and control equipment used at present. Furthermore, such a motor can be used with current of any frequency, whereas up to the present time it has been necessary to supply electrified railroads using a.c. power with current at a frequency of 25 cycles or less. This fact may be of particular interest to central-station companies, as they would be able to supply power to railroads from their 60-cycle power circuits without the costly frequency changer and 25-cycle transformer equipment.

Single-phase a.c. motors for traction purposes can be divided into two main classes: The first class comprises motors whose speed is dependent on the frequency of the current supply. These motors lend themselves readily to high voltages, but they cannot be given a continuous speed regulation. The second class includes commutator motors whose speed can be regulated, but which are limited to comparatively low voltages and frequencies, due to the presence of the commutator. The commutator also makes the construction of the motor and its control very expensive and involves the troublesome difficulties inherent in commutation.

Rectifier valve action replaces commutator

In a motor of the second class it is possible to replace the commutator by a series of electric valves, viz., a mercury-arc rectifier, by the use of which the above-mentioned disadvantages are obviated. As will be seen below, this scheme can be applied to single-phase motors so that relatively high voltages can be used, thus reducing the size and weight of the copper used in the connections. At the same time a very desirable speed-tractive effort characteristic can be obtained. Furthermore, all expensive control, switching and reversing equipment is dispensed with, while only a very simple and cheap grid control is added. Only a very small current is needed for the grid control and the cost of the equipment is naturally low.

In operation, let it be assumed, first, that the rectifier equipment is in the position shown in Fig. 3, and that one grid (of anode z) is positively energized through the distributor. This grid accordingly permits current to flow through the anode which it controls. All other grids will be negatively energized, thus preventing current from flowing through their anodes. As the primary winding of transformer b is energized from the line a half-wave current will flow through the winding of the rotor d and through c_1, as indicated by the arrows. As can readily be seen, the field produced in the windings c_1 and d will produce a torque which causes the field d to rotate and reach, with respect to winding, c_2, the position which it previously had with respect to winding c_1. At the same time the shaft of the motor e brings the brushes of the distributor to such a position that the grids of anodes z and x are now negatively energized, while the grid of anode y is positively energized, permitting current to flow from the anode y into the winding d, and through c_2. The above process is repeated in sequence for all windings of the stator, thereby producing a continuous rotating motion of the rotor.

Rectifier can be given compounding characteristics

It can be seen from the above that the motor simply constitutes a load for a conventional rectifier f, which may therefore be provided with all improvements known to the rectifier art. In particular, the voltage impressed on the stator windings may be regulated by any of the various means of voltage regulation used with rectifiers which can be used here, the voltage being reduced to a low value when the motor is started, and later on being adjusted for purposes of speed regulation. There are also other means for changing the speed or the characteristics of the motor, by a control of the anode grids.

This arrangement utilizes one-half of the applied voltage wave. Commutation of the grid supply permits the utilization of both halves. The regulation of this motor is also effected by means of energized grids and the speed can be varied and the characteristics altered by the same means.

The two motors mentioned above both have series characteristics which are desirable for traction purposes. In the first motor a resistance could be connected across the stator winding, so that the motor can be given the characteristics of a repulsion motor. It is also possible to connect only the rotor to the source of power, in which case the stator circuits are closed only through the rectifier, and the stator currents are obtained

**Abstract of paper presented before A.I.E.E. Great Lakes District Meeting, Milwaukee, Wis.*

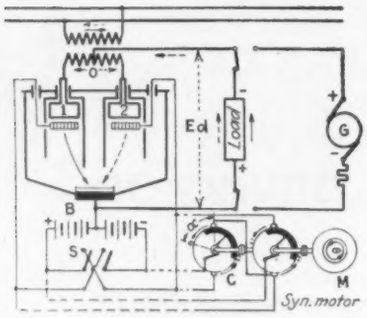


Fig. 2—Inverter operation and regeneration are possible

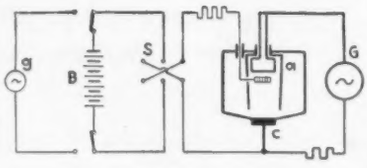
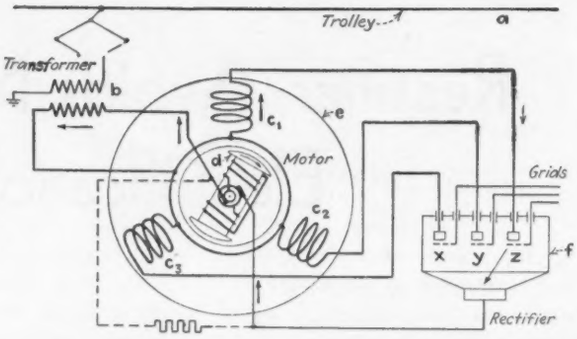


Fig. 1—Grid control gives valve action to rectifier

Fig. 3—Rectifier permits motor without commutator

Each armature winding connects to a rectifier anode with grid control. Motor field and armatures in series give series motor torque and speed characteristic. Salient pole construction not necessary; shown only for schematic explication.



by induction through the rotor. The stator, being then no longer connected to the circuit, can be wound for whatever voltage is found most desirable.

The operation of the transformer, rectifier and motor does not require a source of any definite frequency. This makes it possible to operate the unit with power from either 25-cycle or 60-cycle commercial lighting and power circuits. Moreover, if properly designed, a single motor can be operated on lines of different frequencies. It may even be possible to omit the transformer, and feed the motor directly from the line, through the rectifier. This would result in an arrangement particularly desirable for suburban lines using multiple-unit cars. Only one rectifier is required to control all the motors of one locomotive or motor car. We therefore have a very simple arrangement with the greatest possible range of control, namely, from zero to maximum, using a very light and inexpensive grid-control equipment, and without the least degree of energy loss.

With a suitable arrangement of apparatus this type of motor can also be used for regenerative braking while the locomotive or car is proceeding down grade.

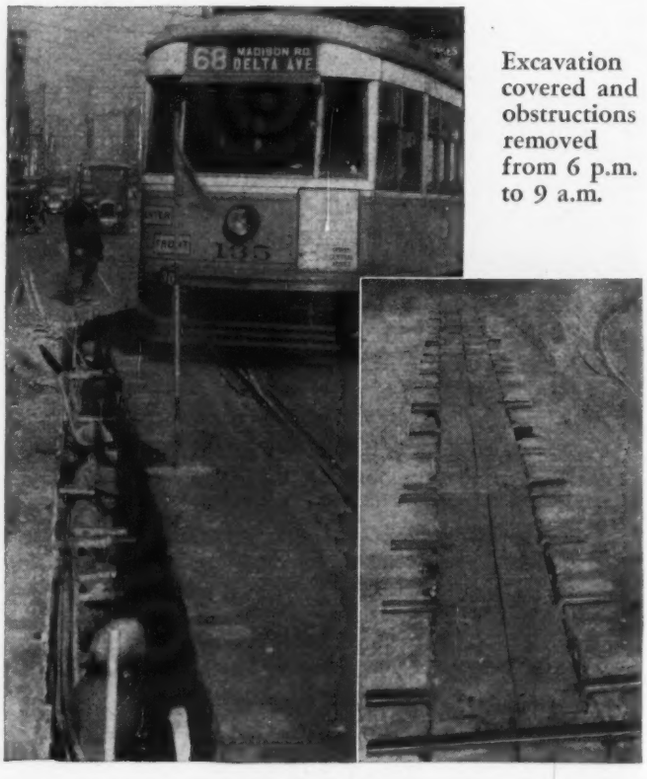
In this connection it is of interest to note that Brown, Boveri & Company, Ltd., of Baden, Switzerland, is at present building a single-phase locomotive to be operated directly with single-phase power of 50 cycles at 15,000 volts. The locomotive is of standard gage, and is equipped with two motors of 500 hp. one-hour rating, for a maximum speed of 90 km. per hour (56 m.p.h.). It is designed for regenerative braking. This locomotive has no commutators, tap switches, starting resistances or reversing switches in the motor circuit. All such equipment is replaced by a high-voltage mercury-arc rectifier with control grids. The tests with this locomotive will be highly significant in view of the possible utilization of alternating currents of commercial frequencies for the electrification of main-line railroads.

▼ ▼ ▼

Traffic Obstruction Reduced While Extending Circuits

Inconvenience to traffic had to be avoided as much as possible when the Union Gas & Electric Company connected its high-voltage underground circuits to the new newspaper plant of the Cincinnati *Times-Star*. This task was particularly difficult because the street excavation for the cables had to pass the intersection of two main traffic arteries. To meet this requirement excavation of the streets was done in ½-block sections. When work on one section was completed the trench was immediately filled and the surface paved. The excavations were made only 20 in. wide and the workmen were started late in the morning (9 a.m.) to avoid conflicting with the dense inward traffic to the business section.

Obstruction of the street during working hours could not be avoided, but from 6 p.m. to 9 a.m. each day the free use of the street by vehicles and pedestrians was permitted by the method illustrated. During this period the street opening was covered with 2-in. planking laid flush with the street level and supported at frequent intervals by 4x1-in. steel bars. In addition to covering the excavation the street was cleared of excavated material and construction equipment. Credit for the solution goes to H. High, foreman of conduit construction.



Excavation covered and obstructions removed from 6 p.m. to 9 a.m.

READERS' FORUM

Manufacturers Eager to Study Users' Problems

To the Editor of the ELECTRICAL WORLD:

Were it not for the prominence of both of your two previous correspondents about specifications, guarantees, etc., the statements made by M. M. Samuels and Charles Fortescue would arouse but passing interest. However, comments made by such as Mr. Samuels, with his years of connection with one of the country's most prominent consulting engineering firms, and Mr. Fortescue, with his association for more than a third of a century with the country's second largest electrical manufacturer, command attention.

The statement was made, on one hand, that "Purchasers' engineers and manufacturers' engineers seldom meet face to face or even in direct correspondence . . ." This claim was questioned by Mr. Fortescue, on the other hand. He said: "This may be literally true of relations between purchasers' engineers and those of small manufacturers, but it is not true of those that exist between the purchasers' engineers and those of the leading electrical manufacturers."

May I be permitted, as a small electrical manufacturer's engineer, to comment in my little way about both of these statements:

Purchasers' engineers and manufacturers' engineers do meet, regardless of whether "leading" or "lagging," and may I add that Mr. Fortescue will find in most cases that this "out-of-phase" relation, for all engineering calculations, is practically negligible.

A manufacturer's engineer, to be familiar with his purchasers' needs, must call repeatedly upon them, and to do this travels annually from about ten to twenty thousand miles. He meets dozens of his purchasers' engineers and has repeated conferences with them as to their difficulties and troubles as far as and sometimes much farther than the particular manufacturer's product is concerned.

A large manufacturer is but an aggregate of a number of small manufacturers. One makes the turbine, the other the generator, the third the transformer, etc., all of which are being sold under one name. Due to the diversified products, the large manufacturer has a greater number of problems to solve and has therefore a greater number of engineers available. Whenever necessary he sends his engineers to his purchasers' engineers to discuss mutual problems. The large manufacturer calls these messengers research engineer, consulting engineer, general engineer, etc.

Since the small manufacturer has neither the money nor the diversified troubles, he has no diversified engineers available either for broadcasting or display purposes. Thus he sends only an engineer. Nevertheless, the result is the same—a mutual good will, understanding and a tolerance toward each others' shortcomings.

No specification has been written yet which could not be circumvented by either of two parties, if they wished to do so. Thus the intent, rather than the words, of a specification must be the guiding spirit. Any competent engineer should be able to draw up a proper specification without any special favor to any manufacturer, and if he does so he will invite a healthy and much desired competition. Afterward he may trust his purchasing agency to obtain for him the best available product in the art.

If special or new devices are required or past mistakes are to be corrected—that is, improvements made—the manufacturer, large or small, will be only too eager to send his engineer to meet the purchasing engineer, providing the purchasing engineer is willing to receive the messenger.

S. I. OESTERREICHER,
Electrical Engineer.
Metropolitan Device Corporation,
Brooklyn, N. Y.

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Three-Motor Drive of 44-In. Slabbing Mill

To the Editor of the ELECTRICAL WORLD:

The article on page 108 of the January 9, 1932, issue of the ELECTRICAL WORLD briefly describes the electrical drive furnished by the Westinghouse Electric & Manufacturing Company for a 44-in. reversing universal slabbing mill. This installation is of particular interest to steel plant and electrical engineers because of the unique method of drive by three direct-current reversing motors and because of the very large size of the mill and its electrical drive.

The 10,000-hp. "twin-motor" drive for the main horizontal rolls has a maximum emergency torque capacity of 3,940,000 lb.-ft. at speeds up to 37 r.p.m. and the 10,000-hp. horizontal roll drive and 2,500-hp. vertical roll drive have a combined maximum emergency output of about 35,000 hp., requiring an input of nearly 45,000 amp. at 700 volts. The continuous and emergency capacities of this drive are nearly a third greater than on any similar mill and the 10,500-kw. motor-generator set which supplies direct-current power to the three reversing motors is the largest in steel mill service.

The system for cooling and ventilating the motor room and electrical equipment is of interest as marking a departure from previously used methods. When carrying the estimated average load imposed by the rolling of 64x30-in.-38,000-lb. ingots to 60x4-in. slabs at the rate of 400 gross tons per hour the electrical losses are on the order of 2,000 kw., requiring the circulation of a very large volume of cooling air to dissipate the heat and maintain the motor room at a comfortable temperature. Usual practice is to install air filters or washers and blowers to furnish clean ventilating air to the machines, the heated air escaping from the motor room through roof ventilators and other openings. Such installations have been moderately successful, but the large filters or washers require considerable attendance and maintenance; in the course of a day a large quantity of dirt will pass even an efficient filter, and during hot weather the temperature may be higher than desirable.

To overcome these difficulties in this new installation the motor-room building is constructed as nearly airtight as possible and a closed recirculating cooling and ventilating system provided. Two 85,000-c.f.m. centrifugal fans, driven by 150-hp., 715-r.p.m. induction motors, draw air from the pits under the motor-generator set and discharge through a 26,850-sq.ft. surface cooler into

the main part of the basement. The cooled air passes through ducts and inclosing endbells to the 10,000-hp. horizontal roll motor and 2,500-hp. vertical roll motor and is discharged into the motor room, whence it is drawn over the motor-generator set and again cooled and recirculated. A 50,000-c.f.m. fan draws outside air through an oil-coated type air filter and discharges into the motor room, to supply make-up air to compensate for leaks and to maintain the room under positive pressure to prevent the infiltration of dirt. The cooler requires about 1,350 gal. of water per minute at 70 deg. F. and it is estimated the motor room temperature will not exceed 105 deg. F. under the worst conditions.

A. F. KENYON,
Steel Mill Engineer.
Westinghouse Electric & Manufacturing Company,
East Pittsburgh, Pa.

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Modulus of Rupture 5,600 Pounds

In the article entitled "Red Cedar Pole Dimension Table," published in ELECTRICAL WORLD, February 27, page 390, the modulus of rupture was given as 600 pounds and should have been 5,600 pounds. Also the phrase "the same class of breaking loads" should be "the same class breaking loads" in line 20.

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BOOK REVIEWS

Communication Engineering

By W. L. Everitt. McGraw-Hill Book Company, New York. 552 pages, illustrated. Price, $5.

Primarily designed as a college text presenting the essential foundations of the fields of communication engineering, the treatment is, however, of such character as to provide radio, acoustical and interference engineers as well as telephone engineers with the mathematical basis of the functions and systems encountered by them. Even power engineers accustomed to deal with single frequencies will find that the generalized principles of multi-frequency behavior will broaden their appreciation of circuit and apparatus phenomena. There is little space given to specific items of telephone or radio equipment in this book, devoted as it is to networks, lines, filters, reflection, attenuation, inductive interference, coupling, bridges, thermionic tubes, modulation, oscillation, radiation. There is a short chapter on high-frequency measurements.

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Messentladungsstrecken (Ionenstrecken)

By Dr.-Ing. Siegfried Franck. Julius Springer, Berlin W 9. 192 pages, 183 illustrations. Price, paper 18.50 reichsmarks, cloth 19.50 reichsmarks.

Development of the electron tube and study of its possibilities continue to bring forward new applications of this device. Here is a book devoted to a discussion of its uses as a measuring instrument. Voltage, current, resistance, capacitance, frequency, time, mechanical velocity, illumination and radiation are among the quantities measurable with its aid. The subtitle indicates that ionic rather than electronic discharges are considered.

The order of treatment is based on physical considerations, hence various applications of a given characteristic appear together; a special index connects these in terms of uses. Because of the variety of applications which the phenomena of the electron discharge seem destined to find, a discussion of this kind is of interest to engineers in a diversity of fields. The present treatment is essentially descriptive rather than mathematical

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Principles of Public Utilities

By Eliot Jones and Truman C. Bigham. Macmillan Company, New York. 784 pages. Price, $4.25.

"Aware of the fact that regulation has failed thus far to safeguard adequately the public welfare," the authors offer an opinionated treatment of that social institution which is public utility service. The Brandeis-Bauer school of thought dominates most of the conclusions on the controversial points of valuation and rate of return. References to decisions and journals are profuse in number; certain ones, however, are cited several times. Illustrations from the field of practice as to rates and accounting, especially depreciation accounting, are meager, the authors preferring to emphasize principles by expository argument.

Friends of private ownership will not find the writers to be blind advocates of public ownership, but they do lean toward federal regulation of the holding company. On the whole, the college students, for whom it is primarily offered, will derive from the text an opinionated but a comprehensive and balanced grasp of the technical, financial, economic, civic and legal elements which cast public utility service into the political arena.

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Alternating-Current Circuits

By J. M. Bryant and J. A. Correll. McGraw-Hill Book Company, New York. Second edition, 492 pages, illustrated. Price, $4.50.

The addition of problems and a chapter on symmetrical phase co-ordinates for unbalanced conditions are the chief features of the new edition of this text book. It is noted for its treatment of circuits as applied to transmission of sinusoidal and non-sinusoidal waves.

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Symposium on Welding

Published by American Society for Testing Materials, Philadelphia, Pa. 152 pages, illustrated. Price, $1.75, cloth bound.

A major portion of the subject matter in the eleven papers assembled in this book treats of testing welds and welded products, including X-ray and magnetographic methods. The balance deals with welding processes, materials and application of methods. Functional classifications are made. Aluminum and high-carbon and other steels are embraced in the discussion.

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Radio Receiving Tubes

By J. A. Moyer and J. F. Wostrel. McGraw-Hill Book Company, New York. 313 pages, illustrated, second edition. Price, $2.50.

The subject matter has been brought up to date and new tubes and equipments are included. Radio surgery is a new and interesting topic added to this book.

Men of the Industry

J. N. Landis Assumes New Duties With Brooklyn Utility

J. N. Landis, who has been connected with the Brooklyn Edison Company since 1923, has recently been appointed mechanical engineer. Mr. Landis first served as technical assistant to the mechanical engineer and subsequently as plant equipment engineer in charge of generating station plant engineering and equipment selection. It was in the spring of 1929 that he was named assistant mechanical engineer. Mr. Landis was born in Champagne, Ill., in 1899 and was graduated from the University of Michigan in 1922.

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GEORGE A. CAMPBELL of Rochester, Vt., has been appointed by Governor Wilson to fill the unexpired term of Henry B. Shaw as a member of the Public Service Commission. Mr. Shaw resigned to resume the practice of law and his place as chairman of the commission has been filled by the appointment of Commissioner Stephen S. Cushing.

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EMERY D. SHERWIN has been appointed assistant general superintendent of the San Diego Consolidated Gas & Electric Company. Mr. Sherwin advanced in the ranks of this utility, having started in the capacity of surveyor. He held successively the positions of estimator, inspector, draftsman, assistant superintendent of electric distribution and assistant superintendent of electric production, the position he occupied until his recent promotion.

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E. V. SAYLES, who has been investigations engineer for the electrical engineering department of Allied Engineers, Inc., Jackson, Mich., now has become general engineer for the Commonwealth & Southern Corporation in Jackson. Mr. Sayles has served on the underground systems committee of the National Electric Light Association and is a member of the Association of Iron and Steel Electrical Engineers.

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HOWARD B. HALL has been appointed director of the industrial division of Murray & Flood, consulting engineers of New York. Mr. Hall is a former manufacturer with broad experience as a reorganizer and in industrial finance.

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MALCOLM R. PITT, Stamford, Conn., has been elected a director of the Connecticut Power Company to succeed the late Walter D. Daskam. Mr. Pitt is a director of the Stamford Trust Company.

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SIDNEY HOSMER, vice-president and assistant general manager of the Edison Electric Illuminating Company of Boston, has been elected a director of the company to replace Robert Saltonstall, resigned.

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G. F. HEUSTIS, since 1927 manager of the Glens Falls division of New York Power & Light Corporation, has been transferred to the general office at Albany, where he will assume duties in connection with industrial development activities of the company. Management of the Glens Falls division will be assumed by THOMAS W. DROUGHT, resident manager at Schenectady. For the present Mr. Drought will continue his duties at Schenectady. Mr. Heustis joined the Adirondack Power & Light Corporation in 1924 as distribution engineer at Glens Falls. In 1926 he was made distribution superintendent and was promoted to resident manager at Glens Falls in the spring of 1927. In the fall of that year he was appointed division manager. Mr. Drought, who succeeds Mr. Heustis, entered the utility business 23 years ago with the Broadalbin Electric Light & Power Company, and for several years prior to the time that company was acquired by the Fulton County Gas & Electric Company was its vice-president and general manager. He continued in charge of operations in the Broadalbin area until 1927, when he was made commercial manager of the Mohawk division, New York Power & Light Corporation. In December, 1929, he was transferred to the general office at Albany as rate engineer, and in July, 1930, was appointed manager of the Schenectady district.

P. A. Tillery Named President of Carolina Power & Light

Paul A. Tillery, formerly vice-president and general manager of the Carolina Power & Light Company, has been elected president of that company to succeed B. F. Jarman, resigned. Mr. Tillery first entered the public utility field as superintendent of the Washington, N. C., municipal electric plant, going to Raleigh on January 1, 1910, as engineer for the Carolina Power & Light Company. Since then he has successively filled the positions of chief engineer, assistant general manager and vice-president and general manager.

Mr. Tillery was born in North Carolina and received his technical education at the Virginia Military Institute, receiving degrees in both electrical and civil engineering. Following graduation, he entered the General Electric "test" at Lynn, Mass., and after a short time joined the teaching staff of the Virginia Military Institute as assistant professor of electrical engineering. As vice-president and general manager he assumed general charge of the Carolina company's operations in North and South Carolina in 1919 and has also served on the company's board of directors since that date.

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A. J. YOUNG, formerly superintendent, has been appointed manager of the electric department for the Carolina division of the Virginia Electric & Power Company. Mr. Young entered the employ of that company during the summer of 1918 and worked in the line and engineering departments during each summer through 1923. After graduation from the Virginia Polytechnic Institute in 1924, he spent one year with the West Penn Power Company, as a student engineer, in each of the major departments of the company. In 1925 he returned to the Virginia Electric & Power Company as maintenance engineer in the Richmond electric department, and subsequently became distribution engineer and then superintendent of that department of the Carolina division.

OBITUARY

B. A. Behrend

Dr. Bernard Arthur Behrend, internationally known designer of alternating-current machinery and consultant on many major developments in the field of electric power generation, took his life at his home in Wellesley Hills, Mass., on March 25 as a result of protracted ill health. Dr. Behrend's long and distinguished career placed him in the front rank of contributors to the theory and practice of heavy power

equipment design. Although he withdrew from resident connection with manufacturing organizations in 1911, when he opened a consulting office at Boston, his advice was sought in much important work on this basis, and only failing health prevented his continuing to serve such clients on an extensive scale with the passing years.

Dr. Behrend was born at Villeneuve, Switzerland, in 1875. After studying with a private tutor and in England he entered the University and Polytechnic Institute of Berlin, graduating in 1894. Coming to this country as a young man he entered the electrical manufacturing field, later becoming chief engineer of the Bullock Company at Cincinnati and chief electrical engineer of the Allis-Chalmers organization, consultant to that company and advisory engineer to the Westinghouse Electric & Manufacturing Company. His contributions to design included original advocacy of high peripheral speeds for water-driven alternators, the study of voltage regulation in alternators serving loads of low power factor, selective ratings of generators and prime movers, use of cylindrical cores with radial slots for turbo-generators, theory and circle diagram of induction motors and use of leakage coefficients. Dr. Behrend's work also influenced the standardization of alternator regulation under A.I.E.E. auspices.

Among the important projects with which Dr. Behrend was associated in earlier days were the linking together at Montreal of the Lachine Rapids and Shawinigan plants, design of frequency changers for Maisonneuve and parallel operation of units driven by three different types of prime movers, parallel operation of gas-engine-driven units and electrical plant development for various subsidiaries of the United States Steel Corporation. More than 70 patents were granted him and he was the recipient of a gold medal at the St. Louis Exposition in 1904, of the John Scott medal of the Franklin Institute in 1912 and of the degree of doctor of engineering from the Institute of Technology at Darmstadt in 1931 for his work in developing induction machines.

Besides about 30 monographs in engineering periodicals, Dr. Behrend was the author of books on induction motors, one entitled "The Debt of Electrical Engineering to C. E. L. Brown," and one on "Engineering Education." He was a past-senior-vice-president of the American Institute of Electrical Engineers, fellow of the American Academy of Arts and Sciences and a member of other professional and scientific organizations.

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CHARLES S. DAVIDSON, who some years ago was connected with the electrical industry, died March 13 in a hospital at Port Huron, Mich. Mr. Davidson is a brother of James E. Davidson, president of the Nebraska Power Company, and a son of the late Wilbur F. Davidson, a pioneer of the electrical industry. He was associated with his brother in the Consolidated Lighting Company at Montpelier, Vt., from 1906 to 1909, at which time he accepted a position as a representative of the Holophane Company at Newark, Ohio. After he severed his connection with the Holophane Company and up to the time of his death he was in the real estate business in Detroit, Mich.

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COL. JOHN F. OSBORNE, for fifteen years an associate of Chas. T. Main, mill architect and engineer, Boston, Mass., died at Chelsea, Mass., March 19 after a brief illness. Col. Osborne was 59 years of age and was well known in the industrial engineering field. He was educated at Harvard University and was associated with the Main organization from 1907 to 1922, where he devoted himself to many industrial projects, having charge of various design and construction jobs for specialized manufacturing concerns and also handling valuations in this field. He had a distinguished overseas service record in the World War, in the command of engineer companies. In later years he had been engaged in building reconstruction and for a time was employed by the Whitney Construction Company on the Edison Electric Illuminating Company of Boston's Kneeland Street steam-heating plant development.

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GEORGE C. HENRY, of Jacksonville, Fla., died at St. Vincent's Hospital March 14, after an illness of one week. He was a consulting electrical engineer. Prior to engaging in his professional work he was for sixteen years local manager of the General Electric Company. He resided in Florida most of his life and in Jacksonville for twenty years. He was a native of New York and moved to Ferdinand, Fla., when a child. He later returned East and was engaged in business there for a few years. Mr. Henry was 54 years of age.

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DAVID E. DRAKE, pioneer electrical engineer and associate of the late Thomas A. Edison, died March 23, at his home in San Diego Cal., after a brief illness. He was 83 years of age. Mr. Drake, who was dean of the sales department of the Westinghouse electric & Manufacturing Company, retired in 1924 after 34 years with the organization. He was superintendent of construction of the United States Electric Light Company when it was absorbed in 1888 by the Westinghouse Electric Company to form the Westinghouse Electric & Manufacturing Company. He continued to engage in the same work, entering the sales department six years later. When he retired he made his home in San Diego.

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PROF. FRANCIS M. HARTMANN, dean of the schools of engineering of Cooper Union and professor of electrical engineering, died March 28, at his home in New York, as the result of an operation. He was 61 years of age. Dean Hartmann was born in Cochecton, N. Y., and received his education at Cooper Union and at New York University. He received some practical engineering training as a city surveyor and a computer for the Department of Public Improvements before joining the teaching staff of Cooper Union in 1899. In 1908 he was appointed professor of electrical and mechanical engineering in charge of the engineering department at Cooper Union and in 1921 became professor of electrical engineering and dean of the schools of engineering, which comprise the night school of engineering and the day department of the Institute of Technology. Dean Hartmann was a fellow of the American Institute of Electrical Engineers and the American Association for the Advancement of Science and a member of the American Society of Mechanical Engineers, the American Physical Society, the American Mathematical Society and the Society for the Promotion of Engineering Education.

Trade News

Allis-Chalmers Manufacturing Company has issued a new amply illustrated bulletin, No. 1154, called Synchronous Motors.

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Ward Leonard Electric Company has established a district office at 53 West Jackson Boulevard, Chicago, under Kline Gray as district manager.

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Ohio Electric Manufacturing Company of Cleveland has recently issued its bulletin No. 211, illustrating a number of special designs of motors, giving dimensions and horsepower. Almost 95 per cent of the company's motors are considered special in certain features and the purpose of the bulletin is to outline the nature of these special features.

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The annual report of the Canadian General Electric Company, Ltd., for 1931 shows net income of $2,308,154 after taxes, charges and depreciation. This is equal after preferred dividends to $9.05 per share and compares with net income of $3,765,797, or $16.76, for 1930.

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An informative booklet on dual-purpose lighting, called Cooper-Hewitt Hygienic Lighting, has just been published by the General Electric Vapor Lamp Company. It shows how health-promoting illumination can be installed immediately in industrial plants already illuminated by standard Cooper-Hewitt lamps.

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Horsburgh & Scott Company, manufacturer of industrial gears and speed reducers, has opened a Chicago district sale office at 844 Rust Street, under H. G. Davis, C. R. Morrison and R. W. Hoyt.

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James R. Kearney Corporation announces the appointment of Alfred C. Wilson, formerly with the Chance Company, as special representative in the southeastern territory.

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Shipments of Kelvinator Corporation refrigeration units for the first two months of this year were more than 18 per cent above the same period of 1931, it was announced by H. W. Burritt, vice-president.

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Net profit of the Weston Electrical Instrument Corporation for the year ended December 31, 1931, after depreciation and federal taxes, amounted to $122,264, equivalent, after class A dividends, to 32 cents a share on 164,000 common shares, against $615,075, equivalent, under participating provisions, to $4.08 a share on 37,400 class A shares and $3.08 a share on 150,000 common shares.

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The Four-Wheel Drive Auto Company, Clintonville, Wis., manufacturer of FWD trucks, announces the appointment of Guy H. Billings as assistant general manager. Mr. Billings joined the accounting department of the FWD organization in 1913. In 1915 he was made purchasing agent and will continue this duty in his new position.

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HIGH-VOLTAGE TRANSFORMER FOR X-RAY WORK

The transformer illustrated is one of two intended for operation of the Lauritsen X-ray tube for cancer research in the Kellogg Radiological Laboratory of California Institute of Technology and was built at the Pittsfield plant of the General Electric Company. Each has a rated capacity of 0.03 amp. at 700,000 volts effective to ground continuously. They are intended for operation in series with neutral grounded, giving 1,400,000 volts effective, or 2,000,000 crest volts, at the X-ray tube.

Western Screw Manufacturing Company of Chicago has been licensed by the Dardelet Threadlock Corporation to manufacture and sell bolts, nuts and screws threaded with the Dardelet self-locking thread.

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United Electric Light & Power Company of New York has just ordered three large Taylor stokers from the American Engineering Company, Philadelphia, for installation in its Hell Gate power station in New York City. Work is to start April 1 and be completed by September 1.

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Reliance Electric & Engineering Company, Cleveland, Ohio, manufacturer of alternating- and direct-current motors, has established a sales branch at 703 Bona Allen Building, Atlanta, Ga., in charge of Messrs. Marshall Whitman and George Gardner. The territory covered from this point will be North and South Carolina and Georgia.

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Phelps Dodge Corporation reports sales during 1931 totaling $50,318,986, against $83,969,978 in 1930. Operations resulted in a net loss of $5,057,376 in 1931, compared with a net loss of $6,281,292 in 1930.

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Electromaster, Inc., announces, the appointment of Lindeman-Hoffer, Inc., as distributor of "Electrochef" in St. Louis and surrounding territory. Louis R. Swenson of Los Angeles has been appointed district manager for the sale of "Electrochef" on the West Coast.

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A new and expanded catalog has just been published by the Ilg Electric Ventilating Company, manufacturer of self-cooled motor propeller fans, blowers, air-conditioning apparatus, etc., covering the various phases of ventilation and air conditioning from a thoroughly up-to-date standpont.

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Prices of all General Electric refrigerators, both domestic and commercial models and units, have been reduced from 3 to 23 per cent, it is announced by P. B. Zimmerman, manager General Electric Refrigeration Company.

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Ohmite Manufacturing Company of Chicago announces the publication of the Ohmite rheostat bulletin No. 12, illustrating and describing model J and I Ohmite all-porcelain rheostats.

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At a stockholders' meeting held on Friday, March 11, the DeForest Radio Company was authorized to purchase the assets of the Jenkins Television Corporation. The consolidation of interests completes the plans of the DeForest Company, begun with the acquiring of a controlling interest in the Jenkins Corporation through an exchange of stock some two years ago.

New Equipment Available

Coated Electrode for Aluminum Welding

An electrode for welding aluminum, known as "Aluminweld," which is a 5 per cent silicon aluminum alloy and can be used for welding sheet or cast aluminum, has been announced by the Lincoln Electric Company, Cleveland, Ohio. It is designed for either metallic or carbon arc welding. It is provided with a coating which prevents excessive oxidation and will dissolve any aluminum oxide that might be formed. The manufacturers claim that the coating assists in giving a very smooth operating arc, which is essential in welding aluminum.

The resulting weld is very dense without porosity and possesses high tensile strength. In its use a short arc of approximately 20 volts should be held with the coating practically in contact with the work. The current to be used will vary with the thicknesses of sheet or material to be welded.

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Earth-Boring Machine

A heavy-duty earth-boring machine, known as the model "HC," is announced by the Highway Trailer Company, Edgerton, Wis. It is rugged in design and has power to operate with the largest truck or tractor motor in the most difficult soil conditions, it is claimed. The machine is provided with a power-leveling device that permits the operator to swing the auger to any desired angle by merely touching the control lever, dual-boring control that permits the operator to handle the machine either from the ground or the truck platform, full reclining auger rack bar that lies flush with the truck platform when not in use, direct-boring machine drive that eliminates the use of driving chains and drive hangars, and double blade gate type auger.

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PORTABLE ENGINE-DRIVEN WELDERS which meet the demand for a superior and reliable source of welding current where electric power is not available are offered in 200, 300, 400 and 600 amp. capacities by the General Electric Company and mark the entrance of this organization into this field. These units are powered by Buda gasoline engines. In the development of these sets the designers have kept uppermost in mind the severe requirements of such service as pipe-line welding, where the use of heavily coated electrodes necessitates arc voltages up to 40 or more. As a result these welders are capable of supplying rated current at high voltages without overloading the generator.

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A PRESSURE-TEMPERATURE CONTROL of the reverse-acting type, the horsepower rating of which is guaranteed for not more than 1 hp. a.c. up to 220 volts and ½ hp. d.c. up to 220 volts, is announced by the C. J. Tagliabue Manufacturing Company, New York. The range adjustment is made by turning the dial on the outside top of the case, and the differential setting is made on the inside of the case.

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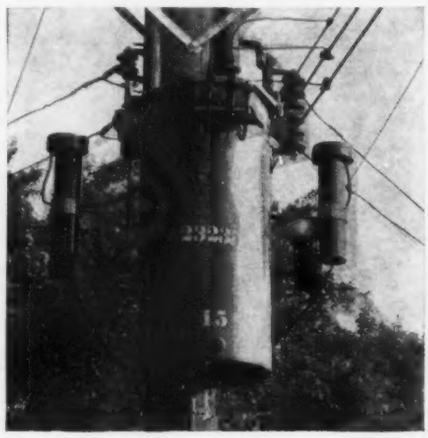
Unit Mountings for Distribution Equipment

Equipment for unit mounting of single-phase distribution transformers, lightning arresters and cutouts, for circuits of 4,600/8,320 Y volts and below, has been announced by the General Electric Company. Installed on a pole, the



equipment requires less space than the conventional crossarm installation of five separately mounted devices. The entire assembly is fastened to the pole with two bolts, dispensing in each installation with two suspension hooks and a crossarm with its insulators. It provides more secure mounting for the transformer and increased safety for linemen.

Time and cost of installation are reduced, since all parts are assembled in the storeroom or on the ground and lifted to the pole as a unit with ordinary block and tackle. No special transformer derrick is needed.

Blind Can Now "See" Black and White Pages

An electrical device was demonstrated at the third conference of Technical Experts in the Printing Industry, held recently in New York, which enables a blind person to read any book, magazine or newspaper or even visualize the appearance of graphs, diagrams or intricate designs. In fact, it will reproduce in embossed form on metal foil whatever is printed in black and white and will do so in a variety of degrees of magnification.

The device consists essentially of an optical system for sweeping a beam of light across the material to be reproduced and receiving the reflected light in a photocell; the output of the photocell actuates a magnet-operated point that traces varying depth impressions on metal foil. For every dark spot on the original there is an embossed spot on the metal foil. The apparatus is known as the automatic printing "Visagraph."

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Double-Range Insulation Tester

A super-meg having two ranges, 0 to 100 and 0 to 1,000 megohms, with a 500-volt constant potential generator, is announced by the James G. Biddle Company, Philadelphia. This super-meg is suitable for making routine tests of insulation resistance on almost all types and sizes of electrical equipment, since its range is high enough to cover the normal insulation resistance of most apparatus. It is intended for engineers and others who have needed a lightweight, low-cost megger instrument which would do considerably more in detecting and preventing electrical trouble than was possible previously.

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Two-Function Automatic and Semi-Automatic Starters

A new line of automatic and semi-automatic starters for synchronous motors is announced by Cutler-Hammer, Inc., Milwaukee, Wis. Important in the operation of these new starters is a frequency responsive relay which functions in connection with an adjustable time-delay thermal overload relay. In the case of either heavy overload, reduced line voltage, failure of motor field or loss of d.c. excitation the frequency relay disconnects the field switch and permits the motor to operate as a squirrel-cage motor for a period of about 30 seconds, depending upon the setting of the thermal overload relay. These starters are made in sizes from 25 to 600 hp. for voltages of 220, 440, 550 and 2,200.